A COMPARATIVE STUDY OF ATTEMPTS TAKEN BY CRIMINAL OFFENDERS TO ALTER AND MASK DECOMPOSITION

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Abstract: Within a few minutes of death, insects facilitate decomposition. The process of decomposition and insect life cycles become evidence to the criminal investigator. However, criminal offenders may try to alter or mask decomposition to prevent their crimes from being discovered. The use of chemicals is one common method a criminal offender may use to hide a crime. How these chemicals effect decomposition is not well known. Some chemicals reduce odors and prevent insects from locating the body; some chemicals repel insects outright. Changes in insect patterns can alter time of death estimations and therefore effect time of death estimations.

This research questioned forensic pathologists, forensic anthropologists, forensic archaeologists, and death scene investigators throughout Oklahoma to compile experience with criminal offenders attempting to alter and/or mask decomposition of crime victims. The questions focused particularly with the use of chemicals. Chemicals used and identified from a questionnaire included lye, bleach, and Febreze®. Other chemicals included N,N-Diethyl-meta-toluamide (DEET) insect repellent and a more natural remedy, Avon® Skin So Soft original body lotion because of its use as an insect repellent. I performed an experiment to test the effects of these chemicals on decomposition rates of animal cadavers; followed by a statistical analysis to determine significant differences between decomposition rates in the presence of chemicals.

Results showed that when comparing the data sets from both experiments, the chemicals applied to the animal cadavers showed no statistically significant differences in decomposition rates. I performed a one-way ANOVA of the differences in weights, a one-way ANOVA of the weight ratios, a type 3 tests of the fixed effects of time and chemical treatment, as well as looking at the simple effects of the treatments given time. All of the statistical analyses provided p-values above the $p<0.05$ level, indicating no significant differences. The only significant difference to decomposition rates reported was time. In conclusion, despite the efforts I made to alter or mask decomposition by applying different chemicals, none of them appeared to significantly impact decomposition. However, observations were documented suggesting differences in the way fur-bearing animals decompose compared to non-fur-bearing animals providing questions for additional research.

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CHAPTER I

INTRODUCTION

Decomposition follows death. This condition becomes a tool for the crime scene investigator who wishes to identify the criminal offender. Key issues criminal investigators face when they respond to a crime scene is that they do not know when the victim died and who killed the victim. Within a few minutes after death, decomposition begins and is mainly facilitated by insects (Vass et al., 2002). Because insects usually arrive first at a crime scene, insects provide a great amount of information. Blow flies are the most common species found near decomposing remains. After blow flies arrive at a corpse, they immediately lay eggs; or they feed on the corpse before they begin oviposition (Lord & Rodriguez, 1989). When insects feed on decomposing remains, they aide the process of decomposition.

Blow flies remain especially useful to crime scene investigators because they have a known life cycle that helps investigators estimate a time of death (Weiss, 1998). However, criminal offenders may try to alter or mask decomposition to prevent their crimes from being discovered. The use of chemicals provides one common method a criminal offender may use to hide a crime. How those chemicals affect decomposition is not well known. A criminal may use chemicals including lye, insect repellent, bleach, or Febreze® to try to hide a body by reducing odors. Reducing odors may prevent insects from locating the body right away; or the use of some chemicals may repel insects from approaching the body, the same way we try to keep mosquitos

away from us. The change in insect patterns can alter the time of death estimation. This new time of death estimation may change the time frame of the investigation for the crime scene investigators.

Previous studies examined limited chemicals. The most common studies include those on lye and DEET insect repellents because of a common belief that these two chemicals speed up the process of decomposition. However, several studies established that these two chemicals do not drastically change the rate of decomposition (Charabidze, Bourel, Hedouin, & Gosset, 2009; Grassberger & Frank, 2004; Mann, Bass, & Meadows, 1990; Schotsmans et al., 2012; Shelomi, Matern, Dinstell, Harris, & Kimsey, 2012). Most studies focus on a single chemical and do not compare the effects of the chemical to the effects of other chemicals. With such a variety of easily accessible chemicals, we lack a good understanding of how chemicals effect decomposition. Little research has been conducted to compare the effects of chemicals on decomposition rates.

A potential benefit of this study may be to provide information on how chemicals effect decomposition rates to aid criminal investigators in future death scene investigations. This study contributes to the existing literature by providing information on the comparison between the effects of chemicals on decomposition rates. Criminal investigators can use this information to estimate a more accurate time of death.

The purpose of this study is to examine and compare the effects of common chemicals on decomposition rates. This study incorporated a mixed-methods approach to first identify chemicals previously observed in Oklahoma criminal cases and then to feature an experiment to test the effects of these chemicals on decomposition rates.

I incorporated an exploratory sequential design that included qualitative, experimental, and quantitative components (Creswell, 2014). The use of multiple methods provided me with more comprehensive answers to the research questions to arrive at a final conclusion. First, I

created a questionnaire for the qualitative data collection. I sent the questionnaire to a selected sample population that consisted of forensic anthropologists, forensic pathologists, forensic archaeologists, and death scene investigators employed by the Office of the Chief Medical Examiner in Oklahoma. I designed the questionnaire so that the responses identified chemicals previously observed in criminal cases in Oklahoma to alter or mask decomposition. Responses to the questionnaire provided the data to conduct the second phase of this study.

I then compiled the results of the questionnaire to create a list of the chemicals previously observed in Oklahoma cases. I chose five common chemicals based on the questionnaire responses and the literature review, and then tested those five chemicals using an experimental method. The second phase of this study, the experiment, used animal cadavers treated in chemicals, chosen from the questionnaire responses and literature review, in order to test the effects of these chemicals on decomposition rates. During the experiment, I measured the rate of decomposition to gather quantitative data for the third phase. The experiment was replicated, and the data sets were compared.

The final phase of this study consisted of a statistical analysis to gather quantitative results. I used analysis of variance (ANOVA) methods to determine if any significant differences between decomposition rates of animal cadavers after being treated with different chemicals existed. The results of the ANOVA provided information that can be compared and analyzed to determine if certain chemicals significantly alter decomposition rates in comparison to other tested chemicals.

This research process allowed for the examination of the effects of chemicals on decomposition rates and provided data that can be used in future investigations to estimate accurate time of deaths involving chemicals. The information gathered in this study can provide

investigators with a more accurate time frame to determine time of death in order to assist in criminal cases.

CHAPTER II

REVIEW OF LITERATURE

Criminal offenders may try to alter or mask decomposition to prevent their crimes from being discovered. Several factors play a role in the effectiveness of such attempts. To detect these attempts, one must understand the process of decomposition and the factors that affect it. This literature review provides information regarding the process of decomposition and the role of forensic entomology in detecting such attempts, as well as previous studies that reported some insect repellents and deodorizers affect decomposition.

2.1 Decomposition

Human decomposition begins approximately four minutes after death (Vass et al., 2002). During decomposition, the body starts to degrade and break down as normal bodily functions cease. Two main processes, putrefaction and autolysis, break down tissues (Lanter & Wiens, 2017). Putrefaction and autolysis provide a predictable sequence of events that occur as the body decomposes (Byard & Tsokos, 2013). Autolysis occurs in a living organism but only removes injured or dead tissues (Lanter & Wiens, 2017).

According to Vass et al. (2002) and Lanter and Wiens (2017), autolysis occurs when a cell self-digests by actions of its own enzymes due to increased acidity. After death, autolysis takes place throughout the body due to the increase in carbon dioxide as oxygen levels decrease.

The cells are poisoned as wastes begin to accumulate and the body becomes more acidic. Cellular enzymes, including lipases, proteases, and amylases, self-digest cells from the inside out, which causes cells to rupture and release nutrient-rich fluids. Organs with increased enzymes and high-water contents, including the pancreas, liver, brain, and stomach, breakdown more rapidly; but all cells eventually break down (Vass et al., 2002; Lanter & Wiens, 2017).

2.1.1 Autolysis and Putrefaction. Autolysis begins at the cellular level and therefore takes time to become noticeable (Lanter & Wiens, 2017). Once autolysis begins, skin and internal tissues degenerate (Rao, 2013; Lanter & Wiens, 2017). The first visible effects of autolysis include pale skin, fluid-filled blisters, and skin slippage (Vass et al., 2002; Lanter & Wiens, 2017). As cells breakdown between the two layers of skin, the epidermal layer separates and slips away from the dermal layer, known as skin slippage or the sloughing of tissues (Lanter & Wiens, 2017). While the external tissues self-destruct, the internal organs and soft tissues also degenerate (Lanter & Wiens, 2017). As cells continue to rupture, fluids rich in nutrients start putrefaction (Vass et al., 2002; Lanter & Wiens, 2017).

Putrefaction accompanies autolysis in initial tissue breakdown. Micro-organisms, including bacteria, fungi, and protozoa, help break down soft tissues after death (Vass et al., 2002). Anaerobic bacteria in the digestive tract consume, digest, and excrete cellular proteins of the body (Lanter & Wiens, 2017). These cellular proteins transform into gases, liquid, and small molecules that get trapped within body cavities (Vass et al., 2002). Bacteria also excrete gases and organic compounds as cells break down (Lanter & Wiens, 2017). Trapped within the body cavities, gases and bacteria build up and then move through the circulatory system (Lanter & Wiens, 2017). The gases and bacteria weaken body cavity tissues and eventually rupture through the skin to be released (Lanter & Wiens, 2017).

The creation and release of gases in tissues may cause disfiguration of the body (Rao, 2013). The body bloats, and the lower abdomen may become discolored due to gases trapped within the body and tissue break down (Lanter & Wiens, 2017). The lower abdomen may turn green, blue, or purple depending on the decompositional stage due to formation of sulfhemoglobin in blood (Vass et al., 2002). As gases try to escape the body cavity, fluid-filled blisters form on the skin. Decompositional fluid, or purge fluid, forms as cells break down (Lanter & Wiens, 2017). Often mistaken for blood, purge fluid commonly escapes through natural orifices including the nose and mouth (Lanter & Wiens, 2017). Once gases purge from the body, active decay begins (Vass et al., 2002). During active decay, gases and fluids are rapidly released; aerobic and anaerobic bacteria remain largely present; and insect activity and carnivores aid in decomposition (Vass et al., 2002 Lanter & Wiens, 2017).

2.1.2 Livor Mortis, Rigor Mortis, and Algor Mortis. As reported by Lanter and Wiens (2017), some internal postmortem changes can be more visible than cell degeneration. After death, blood in the body settles and pools in areas closest to the ground, known as *livor mortis* (Saferstein, 2016; Lanter & Wiens, 2017). Livor mortis presents a blue-purple or purple-red color due to hemoglobin in the blood (Saferstein, 2016; Lanter & Wiens, 2017). After death, organs within an organism shut down and blood no longer circulates (Houck & Siegel, 2015). Blood stops moving and settles wherever gravity pulls it, creating a bluish color against the skin. Hard surfaces push blood out of areas in contact, causing blood to pool in surrounding areas (Lanter & Wiens, 2017).

According to Lanter and Wiens (2017), livor mortis can begin as soon as 30 minutes after death. In initial stages of livor mortis, lividity can be blanched (James, Nordby, & Bell, 2014). In other words, an area of skin turns white due to pressure and does not return to the original color until pressure is released (Saferstein, 2016). If a body is relocated or moved to a new position, lividity can change before becoming fixed (Lanter & Wiens, 2017). Fixed lividity occurs when

blood enters extracellular spaces of the body (Lanter & Wiens, 2017). Once fixed lividity develops, the discoloration cannot be blanched or changed due to any positional movements (James, Nordby, & Bell, 2014; Lanter & Wiens, 2017). Fixed lividity sets at various times depending on the body and its environment (James, Nordby, & Bell, 2014). Livor mortis assists in cause of death determinations based on coloration and location of lividity (James, Nordby, & Bell, 2014; Lanter & Wiens, 2017). If lividity patterns do not match the position of the body when found, then the lividity patterns provide evidence that the body position changed (Lanter & Wiens, 2017).

Rigor mortis, another early postmortem change, occurs when muscles begin to stiffen. After death, the body no longer produces adenosine triphosphate (ATP) as fuel and energy (Lanter & Wiens, 2017). As production of ATP ceases, acidity in the body increases and causes cellular cytoplasm to gel (Vass et al., 2002). ATP depletion causes actin and myosin fibers of muscles to bind, and entire muscles stiffen in their current positions (Lanter & Wiens, 2017). As decomposition continues, actin and myosin fibers degenerate and bonds break, causing rigor mortis to disappear (Lanter & Wiens, 2017). Rigor mortis normally appears about two hours after death, reaches its maximum approximately 6 to 12 hours after death, and normally disappears in about 24 to 36 hours (Houck & Siegel, 2015; James, Nordby, & Bell, 2014; Lanter & Wiens, 2017). As a temperature-dependent process, rigor mortis lasts longer in colder temperatures and displays the body position after death (Saferstein, 2016; Lanter & Wiens, 2017). If rigor mortis does not match the body position at the time of discovery, then the body position provides evidence of movement after rigor mortis started (Saferstein, 2016; Lanter & Wiens, 2017). During putrefaction, gases accumulate subcutaneously (Tsokos, 2005; Byard & Tsokos, 2013). The accumulation of gases can also cause limbs to stiffen, resulting in *putrefactive rigor mortis*, a condition which differs from rigor mortis caused by the depletion of ATP (Tsokos, 2005; Byard & Tsokos, 2013).

Algor mortis, the postmortem cooling of a body, occurs early on as another initial postmortem change, according to Lanter and Wiens (2017). Normal body temperature remains around 98.6°F. After death, blood no longer circulates or regulates internal temperatures, causing body temperatures to cool and adjust to environmental temperatures (Saferstein, 2016). However, other factors, including clothing, water, wind temperature, body mass, exercise, illness, health status, and location of the body, can affect the decrease in body temperatures (Saferstein, 2016; James, Nordby, & Bell, 2014; Lanter & Wiens, 2017). Other factors that may alter environmental temperatures include air conditioners, heaters, and fans (Saferstein, 2016; Lanter & Wiens, 2017).

Marbling of skin, another postmortem change, can occur early on, as reported by Lanter and Wiens (2017). Marbling occurs along blood vessels, causing them to become more apparent so that the skin appears marbled with blue and black like lines. Discoloration starts to spread to other areas including the face and neck. The eyes, tongue, and anogenital areas begin to swell like the abdomen due to cells breaking down. Over time, strong odors accompany the breakdown of the cells. As break down continues, tissues slowly turn into liquids and produce gases. These liquids and gases darken and dry out the skin, tongue, lips, and scrotum as hair also begins to fall out (Lanter & Wiens, 2017).

2.1.3 Other External Factors. Several other external factors can affect decomposition. Under ideal conditions, a body can become nearly or completely skeletonized in two to four weeks, but the body would need to be in warm to hot weather (Mann et al., 1990). Cold weather causes the opposite effect. Cold weather may reduce or prevent decay or act as preservation for the remains (Mann et al., 1990). However, some discoloration of skin can appear orange, black, or even both, and the body can be covered with patches of mold (Mann et al., 1990). The three most influential factors on human decomposition include temperature, access by insects, and burial depth, with temperature having the greatest effects (Mann et al., 1990). Environmental conditions become important when locating a body in a natural setting. Recording of

environmental conditions, including nature of the terrain, season, rainfall, humidity, daily temperatures, insect activity, state of decomposition, and any other bodily changes, remains beneficial to investigations (Mann et al., 1990). The environmental factors work together to alter decomposition rates. In an experimental setting, environmental factors become impossible to isolate or control due to their intermingling (Mann et al., 1990). Difficulty controlling any one variable could cause biased experimental results.

Additional factors, including state of, immediate location of, and clothing on a body, also alter decomposition rates. Unlike a body with no trauma, according to Mann et al. (1990), those with penetrating wounds or gross trauma quickly attracts flies and other insects. Earlier arrival of insects to a body increases decomposition rates. Decomposition also relies on the location of a body. Due to the protection from environmental factors, including insects and weather, buried bodies decay more slowly than bodies on the surface. Various surfaces affect decomposition rates differently; thereby, concrete surfaces cause slower decomposition rates than forested surfaces. Clothing provides protection from environmental factors, including sunlight, rain, and some wind, also changing decomposition rates. However, maggots and insects burrow underneath clothing to avoid sunlight, thus increasing decomposition rates (Mann et al., 1990).

Other factors also affect decomposition. Embalming fluid, a common chemical used on decomposing humans, greatly slows the rate of decay (Mann et al., 1990). Obesity, which causes the body to retain heat, plays a role by speeding up decomposition (Byard & Tsokos, 2013). If provided access to the body, carnivores play a huge role in decomposition according to Mann et al. (1990). Carnivores eat soft tissues of a body, especially the face and hands, greatly increasing decomposition rates. Carnivores target spongy ends of longbones, the pelvis, and vertebrae, whether fresh or greatly decayed. Smaller animals including rodents can also cause widespread damage to a decomposing body. Small rodents tend to target smaller bones including hands and feet and occasionally the face and abdomen. Rodents tend to carry away body parts, particularly

fingers and toes, to other locations usually found a few feet away from the body. However, recording absence of carnivore activity remains important. No evidence of carnivore feeding indicates that carnivores lacked access to the body (Mann et al., 1990).

Like carnivores, insects also come to feed on the body and use the body as a suitable environment to lay eggs. As the population of insects continue to grow, the damage to the body also grows. Insects can cause wounds to a body that appear to be inflicted that could be misinterpreted as a result of foul play relating to death (Byard & Tsokos, 2013). Often, the maggots enter the body cavities and burrow down into wounds, so that the body acts as a shield for maggots, protecting them from environmental factors such as wind and rain (Mann et al., 1990). No matter what occurs outside of the body, the maggots continue to feed (Mann et al., 1990). The insects present on the body provide evidence that can be used to estimate the minimum postmortem interval (PMI) to aid forensic investigations.

Section 2.2 Forensic Entomology

Forensic entomology, a subfield of forensic science, helps determine the minimum PMI. Insects can be used to determine the time of death, the location of death, and any other details related to that death. Forensic entomology is described as the "application of the study of insects and their arthropod relatives in legal proceedings" (W. Spitz & D. Spitz, 2006). Using a known growth cycle of a specific species provides the most precise method to determine the time of death and any relocation of the body since death (W. Spitz & D. Spitz, 2006; Prahlow & Byard, 2012; Anderson and VanLaerhoven as cited in Grassberger & Frank, 2004).

Insects provide a great resource because of their predictable growth rates and succession. Known life cycles provide a reliable source to make a timeline of events related to the death of an individual (Benecke, 2001). The insect's life cycle can be used to determine a time for attraction, arrival, feeding, and breeding on the body (Benecke, 2001). However, absence of insects provides

valuable information to investigations. For example, protection from outdoor exposure prevents insects' access to the body (Weiss, 1988).

According to Lord and Rodriguez (1989), approximately 125,000 to 150,000 different species in the insect fauna exist, providing a wide array of insects available to forensic entomologists. Because insects do not always have a constant source of food, they have adapted and evolved over the years to have better locomotion skills to locate carcasses and arrive first. Insects that easily adapt can live in almost every habitat and situation imaginable. Since insects play a key role in decomposition, knowledge of their life cycles remains important to death investigations. Fly larvae consume a huge portion of organs and tissues before other insect groups arrive at a body. As the body starts drying out, other insects, including beetles, arrive to continue decomposition (Lord & Rodriguez, 1989).

2.2.1 Blowfly. The Calliphoridae family contains about 90 known species, of which approximately 40 species, including blowflies, can be used to determine a PMI (W. Spitz & D. Spitz, 2006). The blowfly, the most common, usually arrives at a body first (W. Spitz & D. Spitz, 2006). This well-known species continues to be the best for death investigations because of its predictable larval development, behaviors, and geographic distribution patterns (Weiss, 1988). Blowflies have seven known stages of development starting with: an egg stage, four larval stages, a pupal stage, and an adult stage (W. Spitz & D. Spitz, 2006).

Blowflies usually arrive at a crime scene first, within minutes to a few hours after death (Lord & Rodriguez, 1989). Upon arrival, they either immediately lay eggs or feed on the corpse first before laying eggs (Lord & Rodriguez, 1989). Natural body openings or open wounds remain a prominent location for eggs (Lord & Rodriguez, 1989). Depending on external factors, for example the wind, blowflies can typically lay up to 2,000 eggs throughout its lifetime (Saferstein, 2016). During colder months, fewer eggs may be deposited for warmth in less

noticeable locations, for example, under the eyelids (Lord & Rodriguez, 1989). Depending on the species and conditions of the environment, an egg typically hatches within one to three days and produces worm-like creatures called larvae or maggots (Lord & Rodriguez, 1989). Large groups of larvae typically hatch at the same time and then move together as a group around the body (Lord & Rodriguez, 1989).

A blowfly larva becomes full grown within several days, depending on several factors, including the species, the number of larvae present, and the environmental conditions (Lord & Rodriguez, 1989). For example, cold temperatures may greatly hinder development to adulthood as well as the production of eggs (Saferstein, 2016; Lord & Rodriguez, 1989). Empty pupal cases and newly emerged flies on a corpse provide evidence that an entire blowfly life cycle occurred on the body (Saferstein, 2016). The life cycle of a blowfly, which typically lasts a few hours up to one month, provides the best evidence for PMI estimations in this timeframe (Saferstein, 2016).

2.2.2 Entomology Case Studies. In a study conducted by Grassberger and Frank (2004), two pigs were laid in a secure backyard in an urban setting to evaluate which insect species could be useful for determining a minimum PMI. Grassberger and Frank (2004) monitored and weighed the pig carcasses weekly and classified the stages of decomposition into four distinct stages. The first stage, considered to be fresh, includes any carcass between the first stage of recent death and the second stage of odorless bloating. This second stage also includes color changes, marbling, bloating or swelling, odors, and purge fluids. The third stage, decay, includes deflation of the carcass, feeding from insects, strong odors, and tissue liquefaction. The last stage, dry remains, includes some cartilage and tissue on bones with odor mostly absent and almost complete skeletonization (Grassberger & Frank, 2004).

Grassberger and Frank's (2004) experiment featured a 60-day observation period. In that time, the first carcass weight reduced to 16% of its original weight. The second carcass did not

reach the dry stage after 60 days and reduced to 20% of its original weight. The experiment showed that colonization of insects coincided with those in other studies, even with an urban location, including the presence of common insects. Insect activity contributed to the weight loss in carcasses following a typical S-curve pattern seen in previous studies.

Several factors affect the patterns of insects and how they colonize, including season and year (Charabidze et al., 2009). Chemicals and drugs represent other factors that could affect patterns of insects. If a person consumes drugs prior to death, then the rate of development of larvae on the body may change in response to feeding on the "polluted" body (Weiss, 1988). Exposure to certain chemicals may deter insects from infesting a body or make location of a body difficult due to masked odors (Mann et al., 1990; Schotsmans et al., 2012). In Leclercq and Vaillant's study (as cited in Aubernon, Devigne, Hedouin, Gosset & Charabidze, 2015), lead arsenate poisoning had distorted the insect colonization on the body and altered the PMI estimations. Marchenko (as cited in Aubernon et al., 2015) also reported that gasoline and paint delayed insect colonization. In recent years, interest in the effects of chemicals on insect colonization and the rate of decomposition increased. Research on chemical effects on decomposition rates remains important to help estimate an accurate PMI.

2.2.3 Insect Activity on Different Carrion. The American Academy of Forensic Sciences (AAFS) held their 70th Annual Scientific Meeting in Seattle, WA during February 19-24, 2018. At this conference, unpublished research was presented about comparing insect activity on different types of carrion. The main focus was the differences in insect activity on carrion such as rabbits, pigs, and humans. There is evidence showing that insects react differently depending on the carrion that is available. For example, if the carcass is an animal with fur, the insects try to find points of entry to avoid the fur. This makes the insects work from the inside of the cadaver out. Insects will find open orifices such as the eyes, nose, and mouth to enter the carcass and then they will feed on the inside of the carcass. For carcasses without fur, such as pigs and humans,

insects will still find open orifices, but they will also feed on the outside of the remains since there is no fur to avoid. This research was presented by Kristi Bugajski, PhD, Angela M. Dautartas, MA, Lee Meadows Jantz, PhD, and Dawnie W. Steadman, PhD from the Anthropological Research Facility (ARF) in Knoxville, Tennessee.

Section 2.3 Insect Repellents and Pesticides

To ensure accurate PMI estimations, investigators need to make note of any changes in patterns of insects. The use of insect repellents or pesticides can deter the insects from colonizing on a body or cause them to arrive later than usual, thereby affecting PMI estimations (Charabidze et al., 2009). Criminal offenders may try to use repellents to cover up their crimes since the use of insect repellents or pesticides could alter or mask decomposition. Increased studies on insect repellents and pesticides need to be performed to better understand their effects on decomposition.

In a case reported by Leclercq (as cited in Charabidze et al., 2009), an almost mummified body with little to no insect activity was discovered. After toxicology tests were performed, results showed lead present in the body, which deterred both police dogs and necrophagous insects from locating the body. Charabidze et al. (2009) performed a study to examine repellent effects of common household products on necrophagous insects. Results showed that some household products (i.e. HCL, patchouli perfume, insecticide, and gas) had significant repellent effects delaying arrival of flies while the controls had no effect on their arrival. The chemicals tested by Leclercq (as cited in Charabidze et al., 2009) resulted in a delay in the colonization and arrival of insects by several hours. However, even though HCL, patchouli perfume, and insecticide had very strong repellent effects, those effects may vary with each case due to external factors (Charabidze et al., 2009).

Gunatilake and Goff (1989) reported a case in which they discovered malathion ($C_{10}H_{19}O_6PS_2$), an insect repellent, in larvae that were feeding on a decomposing body. They analyzed the life cycle of the two-insect species present on the body and estimated a PMI of five days. However, the timeframe between when the decedent had last been seen alive and when the corpse was discovered elapsed eight days. Gunatilake and Goff (1989) discovered the presence of malathion on the body which had delayed the arrival of insects on the body and the species that arrived. Since the arrival of insects was delayed, it caused the PMI to be shortened due to a difference between the time of death and the insect life cycle (Gunatilake & Goff, 1989).

2.3.1 DEET (N,N-Diethyl-meta-toluamide). N,N-Diethyl-meta-toluamide (DEET) is one of the most common active ingredients in most topical insect repellents on the market (Shelomi et al., 2012). DEET possesses a repellent effect on several insects, including multiple species of flies, ticks, and leeches, which consists of all blood-seeking insects (Shelomi et al., 2012). DEET also affects some non-blood feeding insects, including fruit flies, which suggests that DEET contains an "invertebrate-repelling mechanism" (Lee, Kim & Montell as cited in Shelomi et al., 2012; Charabidze et al., 2009). If DEET contains an "invertebrate-repelling mechanism," then DEET should also delay the arrival of necrophagous flies on decomposing bodies (Shelomi et al., 2012). Late arrival of flies may cause an inaccurate estimation of the PMI, due to the estimation being based on the fly life cycles. Inaccurate PMI estimations change the timeframe for crimes and can cause damage to criminal investigations.

Shelomi et al. (2012) performed a study to determine if insect oviposition or arrival time would differ due to a decedent's being treated with DEET. Piglet carcasses were used to help determine any change in insects' decompositional role. Half of the piglets were treated with DEET while the other half were not. Cages were made to protect piglets from scavengers, and window screen trays were placed underneath to capture wandering larvae. Weight of the carcasses recorded over the observation period provided a way to observe the total weight loss

due to decomposition and insect activity. The life stages of the insects present were compared to estimate a PMI. The pigs that were treated with DEET had a PMI of two to three days. However, the control pigs without DEET had a PMI of approximately one week. The control pigs lost almost half of their weight by the end of the experiment, almost doubling the amount lost by pigs treated with DEET (Shelomi et al., 2012).

In the Shelomi et al. (2012) study, the presence of DEET influenced not only the flies, but also other insects including beetles and yellowjackets. Carrion-seeking community insects like beetles and yellowjackets infested some of the control pigs but none of the DEET-treated pigs. This study suggests that DEET made the pigs less attractive to insects even after detection. Late arrival in flies causes a chain reaction, delaying colonization and emergence of larvae and ultimately slowing decomposition rates. Estimation of PMI based on entomology in this case could lead to underestimation and may create a new timeframe and group of suspects for the investigation (Shelomi et al., 2012).

According to Shelomi et al. (2012), DEET does not seem to affect the odor of the carcass. Flies could detect the carcass through the odor produced, but DEET repelled them from colonizing. Mosquito repellent, the most common topical repellent containing DEET, usually repels mosquitos for about 12 hours on average. Shelomi et al. (2012) reported that DEET repelled insects from the pig carcasses for about 12 hours, suggesting that DEET possesses "broad-spectrum insect-repellent activity" not dependent on the application surface.

2.3.2 Importance of Studying Insect Repellents. Insect repellents, especially those containing DEET, seem to greatly affect the arrival and colonization of insects on a decedent. Applying insect repellent before or after death may cause late arrival in insects by 12 hours or more. Since the effects of different insect repellents vary, the study of repellent effects on insect colonization and decomposition rates remain important. Previous studies have tested DEET

repellents, but research is lacking on DEET-free insect repellents. The need to study a variety of insect repellents, with and without DEET, remains crucial to help determine the changes in necrophagous insect patterns due to the insect repellent used. Because insects play such a significant role in PMI estimations and decomposition rates, further research may provide a better understanding of the effects of repellents.

Section 2.4 Odor Repellents and Other Chemicals

Deodorizers may also be used to prevent a body from being found. The use of lime to conceal a body is a common belief and practice (Schotsmans et al., 2012; Schotsmans, Denton, Fletcher, Janaway & Wilson, 2014a). People believe that lime speeds up decomposition rates, leading to reduction in odor and destruction of evidence and all remains (Schotsmans et al., 2012; Schotsmans et al., 2014a). Some other chemicals that spark interest include bleach, perfume, and gasoline. When a person tries to hide a crime, they will use the easiest chemical they can find. If chemicals such as bleach, perfume, or gasoline are already located in the home, then they provide the easiest go-to chemical to use, unlike lime. A variety of chemicals need to be studied to provide criminal investigators a better understanding of the effects of chemicals on decomposition rates.

2.4.1 Lime. Lime possesses disinfecting, deodorizing, and deterring properties, but the effects of lime on the body causes debates (Schotsmans et al., 2012; Schotsmans et al., 2014a). Laudermilk (as cited in Schotsmans et al., 2014a; Schotsmans, Fletcher, Denton, Janaway & Wilson, 2014b) first studied the effects of lime and, based on his experiments with quicklime, determined that lime does not destroy bodies or accelerate the rate of decomposition. Toogood and Diaper (as cited in Schotsmans et al., 2014a) published a study on odors, concluding that lime lessens the initial odor only for the first few weeks after death. Further studies need to be conducted to help answer questions on the effects of lime on decomposition.

Schotsmans et al. (2012; 2014a; 2014b) performed laboratory and field experiments to study short- and long-term effects of three sets of pigs buried with lime. The pigs were either assigned to be covered in powdered hydrated lime, to be covered in powdered quicklime, or to be left uncovered (Schotsmans et al., 2012; Schotsmans et al., 2014a; Schotsmans et al., 2014b). Pigs were buried and then exhumed and examined after 6, 17, and 42 months to determine the effects of lime on decomposition (Schotsmans et al., 2012; Schotsmans et al., 2014a; Schotsmans et al., 2014b). Humans and pigs share similar body structures, except for the quadrupedal leg structure in pigs, which leads to non-supine burials for pigs (Schotsmans et al., 2014a). Burial differences remain a minor issue and do not cause problems with inferences drawn from the study (Schotsmans et al., 2014a).

Powdered quicklime can absorb moisture from the environment, including the ground or remains. As quicklime becomes hydrated, an exothermic reaction occurs that causes an increase in temperature (Schotsmans et al., 2014a). The increase in temperature also causes decomposition rates to accelerate for a short period of time. By the end of the experiment, the uncovered pigs lost 44% of the starting body weight, the hydrated lime pig lost 40% of the starting body weight, and the quicklime pig lost 55% of the original body weight (Schotsmans et al., 2014a). The quicklime pig ruptured due to the exothermic reaction, which led to a higher percentage of body weight being lost (Schotsmans et al., 2014a).

Pigs exposed to lime exhibited a better state of preservation, including unusually well preserved internal organs, than pigs not exposed to lime (Schotsmans et al., 2012). Schotsmans et al. (2014b) provide evidence that if a burial contains lime, adipocere formation may not be observed and lime can inhibit decomposition. The carcasses that were exhumed after 17 months were in an advanced stage of decomposition (Schotsmans et al., 2014b). All carcasses, whether exposed to lime or not, were at a liquifying stage of decomposition with the pig not exposed to lime in a slightly more advanced stage (Schotsmans et al., 2014b). The carcasses recovered after

42 months were completely skeletonized, whether buried with lime or not, with no soft tissue remaining (Schotsmans et al., 2014b).

2.4.2 Lime Casts. Lime tends to absorb moisture and can harden to form a cast around the applied surface. Schotsmans et al. (2012) reported lime casts around pigs exposed to hydrated lime and quicklime and observed a void between the cast and pig carcasses once exhumed. The lime casts formed and hardened while the pigs were bloated during the initial stages of decomposition. As decomposition continued, the pig carcasses began to deflate. The lime cast had hardened in place and created a void in the space between the cast and the shrunken carcass.

Schotsmans et al. (2014b) performed an analysis on the lime cast from the burials after 6, 17, and 42 months to determine the moisture content. This analysis of the lime cast suggested that the lime went from a powder to a creamy substance and then finally formed a hard cast around the corpse (Schotsmans et al., 2014b). The lime cast structure depends upon the time allotted to formation and can form whether the lime begins as powder or not. However, the longer time available for a cast to form, the harder and stronger the cast will be.

2.4.3 Lime Preservation. Lime appeared to preserve the tissues initially exposed to lime (Schotsmans et al., 2012). Pigs exposed to lime had dry, leathery, preserved surfaces on the upper side of the carcass; pigs not exposed to lime appeared to be wet (Schotsmans et al., 2014a). After the removal of lime, odors escaped and became more apparent (Schotsmans et al., 2014a). Overall, decomposition between the pigs exposed to lime and the pigs not exposed to lime remained similar (Schotsmans et al., 2014a). However, internal organs in pigs exposed to hydrated lime showed better preservation (Schotsmans et al., 2014a).

2.4.4 Effects of Lime. Both laboratory experiments and field burials reported that quicklime had the most desiccating properties on tissues and could remove over 60% of moisture from the tissues (Schotsmans et al., 2012; Schotsmans et al., 2014b). The long-term studies

showed that carcasses end up in the same stage of decomposition, whether buried with lime or not. Other researchers have made several assumptions about the effects of lime on a decomposing body, but Schotsmans et al. (2014a) demonstrated that quicklime initially accelerates decomposition rates and possesses some desiccating properties (Schotsmans et al., 2014a).

Schotsmans et al. (2012, 2014a, 2014b) suggested that the use of quicklime initially accelerates decomposition rates, but eventually the decomposition rate slows back down. Hydrated lime and quicklime retard the rate of decomposition considerably over a period of 6 months; however, lime does not change the outcome of decomposition; and all remains undergo skeletonization (Schotsmans et al., 2014a; Schotsmans et al., 2014b). In conclusion, lime did not accelerate or retard decomposition rates significantly enough for the carcasses to be in different stages when exhumed.

2.4.5 Other Chemicals. In general, lime seems to be one of the main chemicals of concern. Disputes continue about the use of lime to hide odors of decomposition, to change decomposition rates, and to destroy decompositional evidence. Some other chemicals have sparked interest, including perfume, gasoline, and bleach, even though lime seems to be the most common "go-to" chemical when someone wants to conceal odor and speed up decomposition.

Aubernon et al. (2015) performed a study to look at some commonly available household chemicals and the effects these chemicals would cause on insects and decomposition. Aubernon et al. (2015) hypothesized that household products can affect arrival times of adult insects as well as the survival and development of larvae. The chemicals chosen for the study were easily accessible common household products based on the Charabidze et al. study (as cited in Aubernon et al., 2015) because they could possibly be used to conceal the carcass or prevent insect development. The chemicals chosen were water (control), bleach, perfume, hydrochloric acid (HCL), caustic soda, insecticide, citronella mosquito repellent, and unleaded gasoline. As a

result of the previous study performed by Charabidze et al. (as cited in Aubernon et al., 2015), high and low quantities of chemicals were chosen based on those normally available in a home.

Aubernon et al. (2015) performed in-vitro experiments with fresh beef liver treated in the chosen chemicals. One hundred first-instar larvae and the treated beef livers were placed inside plastic boxes with ventilated lids. Boxes remained closed for 67 hours before lids were removed so that larvae could relocate to the sand to pupate. Pupae and adult flies were then counted to determine the development changes due to the chemicals (Aubernon et al., 2015).

Aubernon et al. (2015) reported that some of the common household chemicals displayed repellent effects. First, gasoline, HCL, and insecticide all had strong repellent effects for adult flies. Adult flies steered clear of feeding boxes treated with those three chemicals, no matter the quantity; all larvae were killed as well. Second, caustic soda and mosquito repellent had varying repellent effects. Adult flies were not repelled from feeding boxes treated with caustic soda and mosquito repellent; however, these two chemicals were lethal for the larvae at high quantities. Third, perfume did have repellent effects on adult flies but had no effects on larvae and their development. Finally, bleach had no effect on adult flies or larvae and their development, suggesting that bleach does not possess repellent effects (Aubernon et al., 2015).

Section 2.5 Summary of Literature Review

Use of chemicals and insect repellents to cover up decompositional odors or repel insects leaves room for questions. Evidence suggests that insect repellents and chemicals deter insects from approaching decomposing bodies either by reducing odors or repelling insects. DEET, the most common ingredient in insect repellents, can deter insects for 12 hours or more, thereby altering estimations of postmortem intervals (PMI). Other chemicals, including lime, insecticide, and gasoline, may also affect decomposition by reducing odors, repelling insects, or killing the insects. Researchers need to conduct more studies on a wider array of chemicals and their effects

on decomposition rates. The information provided by further studies would help investigators to estimate more accurate PMIs and time of deaths for criminal cases when chemicals are encountered in the field.

CHAPTER III

METHODOLOGY

Research suggests that some people believe chemicals including lye, insect repellent, or Febreze® may alter decomposition (Aubernon et al., 2015; Charabidze et al., 2009; Grassberger & Frank, 2004; Gunatilake & Goff, 1989; Mann et al., 1990; Schotsmans et al., 2012; Shelomi et al., 2012). Far less research compares the effects of these chemicals on decomposition rates. Additional research closes the gaps and aids future investigations by addressing how chemicals may affect decomposition.

The purpose of this study was to examine the effects of common chemicals on decomposition rates. I used a mixed-methods approach to identify chemicals previously observed in Oklahoma criminal cases and then performed an experiment to test the effects of these chemicals on decomposition.

In my research, I implemented an exploratory sequential design because this design allowed the use of more than one method to reach a final conclusion (Creswell, 2014). Each step provides a stepping stone, building more information for the next step. This mixed-methods approach includes qualitative, experimental, and quantitative components (Creswell, 2014). The qualitative component consisted of a questionnaire sent to a selected population to identify previous chemicals observed in past cases in Oklahoma. The experimental component involved the use of the chemicals identified by the questionnaire to test on cadavers and measure

decomposition rates. The quantitative component consisted of an analysis of variance (ANOVA) performed on the decomposition rates.

This study has been submitted to and approved by the Oklahoma State University (OSU) Institutional Review Board (IRB) and is considered exempt human research (see Appendix A). All questionnaire participants are de-identified, and names are kept confidential for their protection and privacy. The research has also been submitted to the Oklahoma State University (OSU) Institutional Animal Care and Use Committee (IACUC) and does not require IACUC approval (see Appendix B and Appendix C).

All recipients of the questionnaire received a Participant Information Sheet (see Appendix D) along with a copy of the questionnaire (see Appendix E). Choosing to fill out and return the questionnaire confirmed consent to participate. Appendix F contains the recruitment script written for the body of the email message sent to the participant group to inform them about the questionnaire and to ask them to participate.

There is no expectation of harm to participants or breach of confidentiality of personal information. No animals were harmed or killed for the purpose of this study.

3.1 Qualitative Method

The qualitative method consisted of questionnaires. The questionnaire helped identify chemicals, including insect repellents and deodorants, previously observed in Oklahoma criminal cases to alter or mask decomposition. This section explains the process for the creation of the questionnaire, selection of the targeted population, administration and collection of the questionnaire, and use of the questionnaire responses.

3.1.1 Creation of Questionnaire. According to Babbie (2007), a questionnaire is "a document containing questions or other types of items designed to solicit information appropriate

for analysis." A questionnaire can involve open-ended or close-ended questions. An open-ended question provides the respondent the chance to answer the question freely in an open space. A close-ended question usually involves particular answers like a multiple-choice question. Close-ended questionnaires seek out certain answers or information while open-ended questionnaires solicit specific thoughts from the respondent. The questionnaire design contains clear and unambiguous items to ensure relevant answers and to reduce confusion and misunderstanding by the respondent which may distort data analysis.

My questionnaire follows the design of open-ended questions to provide respondents the opportunity to answer the questions freely. I provided the questionnaire in a Microsoft Word® document so that respondents can easily access it on a computer and type their answers directly into the questionnaire. If a respondent answers "yes" to a question, then there is a follow-up contingency question, which Babbie (2007) describes as "a survey question intended for only some respondents, determined by their responses to some other question."

The questionnaire consists of 7 questions or items. The questionnaire begins with a general question asking the respondent to discuss any chemicals they observed in past cases to alter or mask decomposition. The next two questions become more specific and inquire about specific chemicals including lye and insect repellents. If the respondent acknowledged a questioned chemical in the first three questions, then the contingency question that follows asks about the effects of that chemical. The fourth and fifth questions inquire about chemicals affecting postmortem intervals (PMI) or time of death (TOD) estimations and any cases where chemicals were suspected but not proven. To gather the background supporting the respondent's answers, the sixth and seventh questions ask official job title and years of experience.

It can be difficult to get a population to complete and return questionnaires. Some respondents may not want to participate or may forget to respond. For this reason, I kept the

questionnaire short, easy, and to the point. The Microsoft Word® document allowed respondents to easily edit the questionnaire due to the selected population's daily access to a computer; this feature allowed respondents to simply save it and electronically return it, ideally increasing the number of responses.

The Participant Information Sheet included with the questionnaire informed the selected population about my research. This form explained the purpose of the research and the general idea of what the questionnaire asks so that the respondent knows what to expect. The Participant Information Sheet also discusses risks, benefits, and confidentiality for any person that chooses to participate. Last, the form provides contact information so that the respondents can ask questions or further discuss the research and questionnaire.

3.1.2 Selection of Participants and Administration of Questionnaire. The targeted population for the questionnaire consisted of forensic pathologists, forensic anthropologists, forensic archaeologists, and death scene investigators in Oklahoma. See Table 1. I selected this specific population because of their responsibility for investigating cases involving human decomposition. Death scene investigators, forensic archaeologists, and forensic anthropologists report to the crime scene to locate the remains. At the scene, they analyze the body and record the condition of the body and surroundings. The forensic pathologists examine the remains last and determine how the individual died and the cause and manner of their death.

Table 1

Questionnaire Sample Population and Location

Office Location	Number of People
Oklahoma City	
Forensic Pathologists	8
Forensic Anthropologists	1
Forensic Archaeologists	1
Death Scene Investigators	9
Tulsa	
Forensic Pathologists	5
Forensic Anthropologists	1
Forensic Archaeologists	0
Death Scene Investigators	8
District Investigators[a]	
Death Scene Investigators	16
Total	**49**

Note. Total number of people refers to the employees that are employed at the current date of December 1, 2017 and is subject to change.
[a]District investigators are not located at either office location. They work within their designated district and then report to one of the two office locations.

Gathering a sample population involving forensic pathologists, forensic anthropologists, forensic archaeologists, and death scene investigators provides a group experienced with criminals attempting to alter or mask decomposition. The experience of the selected population ensured that the items in the questionnaire remained relevant to the respondents. The selected sample population provided responses that identified chemicals previously observed in Oklahoma criminal cases to help me determine which chemicals to test in my experiment.

As an employee for the Oklahoma Office of the Chief Medical Examiner (OCME) Eastern Division located in Tulsa, Oklahoma, I had access to the targeted population for the questionnaire. Deputy Chief Medical Examiner Joshua Lanter, M.D., in Tulsa, Oklahoma, advised me on the administration of the questionnaire. I administered the questionnaire by email, with the recruitment script (see Appendix F) in the body of the email, explaining who I am and a summary of my research to encourage responses.

The recruitment script identified me as a co-worker; therefore, respondents know that I am part of the "work family." The recruitment script also informed the participants that the questionnaire can be completed in approximately five minutes. Once complete, I sent the recruitment script, Participant Information Sheet, IRB approval, and the questionnaire to the Chief Medical Examiner Eric Pfeifer, M.D., in Oklahoma City, Oklahoma, for approval. Once approved, the recruitment script, Participant Information Sheet, IRB approval, and questionnaire were emailed to the sample population employed by OCME.

3.1.3 Collection of results. When a participant completed the questionnaire, the responses could be returned via email. Collecting the questionnaires through email provided quick responses and an easy delivery method since participants work in various regions of Oklahoma. I promised confidentiality to the participants, so I saved the questionnaires in a way to remain confidential.

Upon receipt, I downloaded the questionnaire with no personal information attached and saved the response in a separate file. I labeled the responses, according to order of arrival, as "Response 1," "Response 2," "Response 3," so that responses could not be traced back to the respondent. After downloading the questionnaire, I double deleted the email containing the response to avoid any connection between the questionnaire and the respondent. I stored the responses on a locked personal computer that remained in a locked desk when not in use. I control the only access key to the desk, and the computer is password-protected.

3.1.4 Use of Results. I gathered the responses from the questionnaire to identify the various chemicals previously observed in Oklahoma criminal cases. I created a list of the chemicals from the responses and tallied the responses to determine the most common chemicals observed. Based on the questionnaire responses and the literature review, five chemicals were

selected for the experimental research. I then tested the chosen chemicals in the experiment to observe the effects of the chemicals on decomposition.

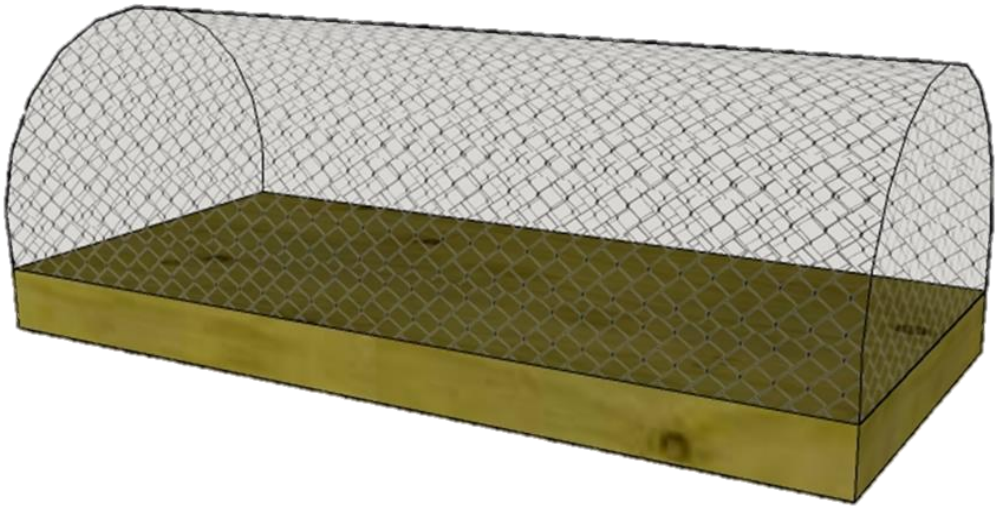
3.2 Experimental Method

The experimental method consisted of an experiment using animal cadavers and the chemicals selected based on results from the questionnaires to observe the effects of these chemicals on decomposition rates. Materials needed for my experiment appear in this section along with explanations of the process of monitoring and documenting the experiment and results, as well as the limitations of the experiment.

3.2.1 Needed Materials. I conducted this experiment using feline cadavers. The experiment consisted of one cadaver for each of the five chemicals selected from the questionnaire responses and one cadaver as a control to equal a total of six feline cadavers. For this experiment, I built cages to protect cadavers from scavengers out of 1x6x18 inch pine-board bases with a curved top made from ½ inch hardware cloth. See Figure 1. I treated the pine board with polyurethane to protect the wood from damage during the experiment. The pine board made the base of the cage and I stapled the hardware cloth to the long sides of the pine board to create an arch. I used semicircle cutouts of the hardware cloth to close the ends of the cage. See detailed instructions in Appendix G.

Figure 1

3-Dimensional Model of Animal Cadaver Observation Cage



Note. These cages were be built to hold and protect the animal cadaver from scavengers during the experiment.

Other materials needed for this experiment include a camera, a digital hanging scale, a composition notebook, laminated tags, and a dry erase board and markers. Each cage was identified with a laminated tag containing the assigned cadaver number and chemical. I used the camera to photograph the cadavers to document the process of decomposition throughout the experiment. The dry erase board identified which cadaver and chemical were represented in the photograph. I used the digital hanging scale to weigh the cadavers, providing the easiest way to measure the change in decomposition; and documented the weather and surroundings, as well as the weight records from the experiment, in the composition notebook. Materials to anchor the cages included normal weight half concrete blocks, Blue Hawk® welded silver steel chains, Blue Hawk® zinc-plated quick links, Hefty® EZ Foil Oven Liners, and blue plastic tarp.

3.2.2 Experiment Preparation and Location. After building the cages for the experiment, I weighed them to determine the initial weight. Six euthanized feline cadavers were acquired. No animals were harmed or killed for the purpose of this study. I assigned one cadaver to be the control for the experiment, and the remaining animal cadavers were assigned a chemical based on the questionnaire responses. I fully coated the animal cadavers in their assigned chemical and then placed them inside the cage and closed it. I then weighed the cage and animal cadaver together. I used the weight of the cage and the combined weight of the cage and cadaver to calculate the initial weight for the cadaver coated in the chemical.

I labeled each cage with the assigned chemical on a laminated tag so that it remained identifiable for each cage and cadaver throughout the experiment. I then placed the cages outside. The experiment was located on the roof of the Investigative Sciences Research and Teaching Laboratory at Oklahoma State University Center for Health Sciences in Tulsa, Oklahoma. This location not only provided an area off the ground to lower the number of scavengers with access to the decomposing remains, but also prevented easy access to bystanders to prevent contamination of the experiment. I used welded silver steel chains to anchor each cadaver cage through the center of a two normal weight half concrete blocks placed on a metal cookie sheet pan. The two ends of the steel chains were attached with a zinc-plated quick link. The cadaver cages were anchored down to prevent bird scavengers from carrying the cages away. I used cut pieces of tarp to lay over the top of the cadaver cages that were anchored under the normal weight half concrete blocks. The tarp provided protection from the weather, including rain, to maintain consistent weight measurements. The sides of the cage were still accessible to insects.

3.2.3 Experimental Observations. Each day I monitored the experiment to record the decomposition process and the change in decomposition rates, as well as the weather and surrounding conditions. I used the Weather Channel App (also found at https://weather.com) to look up weather conditions in Tulsa, Oklahoma, 74107. This app includes not only the daily high

and low temperatures and the current temperature at the time of recording the experiment, but also the humidity, dew point, pressure, UV index, precipitation, and wind.

I documented the process of decomposition in photographs with the dry erase board to identify the animal cadaver and chemical involved in each picture. I photographed the animal cadavers at the same time daily for the duration of the experiment. These pictures allowed me to compare the visible differences in decomposition rates between animal cadavers after being treated with different chemicals after experiment completion.

After reviewing previous studies, I performed the experiment until the point that the weights of the animal cadavers began to plateau. Once the experiment was completed, I replicated the experiment and compared the data sets.

3.2.4 Collection and use of Results. The experimental method provided quantitative data for statistical analysis. I used the digital hanging scale to weigh the cages containing the animal cadavers daily. I used the initial weight of the cage to calculate the weight for the cadaver treated with the chemical, and recorded the calculated weight of the cadaver in the composition notebook with the weather and surrounding conditions daily for consistency.

I created a chart using the weight records for each animal cadaver that portrayed the daily weight and the overall change in weight. The change in weight divided by the number of days of the experiment calculates the rate of decomposition for each animal cadaver. I performed an analysis of variance (ANOVA) on the weight data sets to determine if any relationships existed between the chemicals and decomposition rates.

3.2.5 Limitations of Experiment. The first limitation involved in this study comes from the use of cats as my animal cadavers. Pig carcasses provide excellent models for human decomposition because they share several physical characteristics, including the same bone structure and similar skin. The only major difference is that pigs are quadrupedal, meaning they

walk on four legs, unlike humans who are bipedal and walk on two legs. I selected cats for this experiment due to the smaller size and availability. No consideration was made for the chemicals used to euthanize the cats.

A second limitation involves clothing. In my experiment, the cat cadavers were not clothed. Humans wear clothing in their day-to-day lives, so a higher chance exists of human remains being found with clothing, unless someone purposefully removed the clothing. Clothing can affect the insect succession on a corpse by providing a different living environment for the insects, therefore altering the rate of decomposition.

A third limitation involves the cadaver cages being protected from environmental conditions, including the rain. I used a tarp to cover the top of the animal cadaver cages to protect the cadavers from rain. If I weighed an animal cadaver dry one day and then wet the next day, it would cause inaccurate weight measurements. The tarp ensures that the animal cadavers remain dry throughout the entire experiment. The insects could still access the animal cadavers through the side of the cage. In real life, it is possible for remains to be found covered, however, the remains may not always be covered. The tarp makes conditions slightly less realistic for cases with remains not covered but provides comparable conditions for remains that may be found covered.

Another limitation, environmental conditions, can alter the experiment and decomposition rates. Decomposition occurs more slowly in cold temperatures and speeds up in warm climates. The time of year and weather, including wind and rain, during the experiment can alter the rate of decomposition. Although insects are the main facilitators in decomposition, changes in weather can alter the succession of insects. Therefore, the change in insects can alter the rate of decomposition. The environmental conditions need to be considered for interpretation of results from this study.

3.3 Statistical Analysis

As my final method, I used analysis of variance (ANOVA) to assess the relationship between the decomposition rates of the animals and the chemicals applied.

3.3.1 Analysis of Variance (ANOVA). ANOVA is a "hypothesis test typically used with one or more nominal independent variables (with at least three groups overall) and a scale dependent variable" (Nolan & Heinzen, 2012). I used a one-way ANOVA at a 0.05 level of significance to determine any significant differences among the changes in weight of the animal cadavers after being treated with different chemicals. Weights of the cadavers were recorded throughout the process of decomposition, and a rate of decomposition was calculated for each cadaver.

3.4 Summary

This research used a mixed-methodology approach to integrate my qualitative, quantitative, and experimental data to fully present my information in an exploratory sequential design (Creswell, 2014). The qualitative method consisted of a questionnaire sent to a selected sample population. The research allowed me to record quantitative and observational data.

First, the questionnaire helped identify chemicals previously observed in Oklahoma criminal cases. The chemicals reported in the questionnaire responses identified the chemicals to be tested in the experiment. Secondly, the experiment tested the effects of the chosen chemicals on decomposition rates of animal cadavers. Thirdly, I used the decompositional data from the experimental method in an analysis of variance (ANOVA) to examine significant impacts resulting from various chemicals selected from the questionnaire data. Next, I compared and analyzed the results of the ANOVA to determine how different chemicals may alter decomposition rates. Lastly, I used observational and photographic data to further analyze my results.

CHAPTER IV

FINDINGS

In my research, I implemented an exploratory sequential design that consisted of three different methodologies (Creswell, 2014). This mixed-methods approach included a qualitative stage, experimental stage, and quantitative stage (Creswell, 2014). The qualitative stage consisted of a questionnaire which provided a way to identify chemicals previously observed in past criminal cases in Oklahoma. I discussed results from the questionnaire with forensic pathologists and criminal investigators and chose chemicals based on the questionnaire responses to test in the next stage. The experimental stage consisted of an experiment with animal cadavers, which allowed the opportunity to observe the effects of the chosen chemicals on decomposition rates and processes. The final stage, the statistical analysis, consisted of an Analysis of Variance (ANOVA) to determine significant differences between the decomposition rates of animal cadavers after being treated with different chemicals.

4.1 Qualitative Methodology

The first method in my research project consisted of a questionnaire to help identify chemicals previously observed in past criminal cases in Oklahoma. I sent the questionnaire to 49 participants within the Office of the Chief Medical Examiner in Oklahoma. I compiled the results from the questionnaire responses, discussed these results with forensic pathologists and criminal investigators, and used this data to choose chemicals to test in my experiment.

This study has been submitted to and approved by the Oklahoma State University (OSU) Institutional Review Board (IRB) and is considered exempt human research (see Appendix A). All questionnaire participants are de-identified, and names are kept confidential for their protection and privacy. All recipients of the questionnaire received a Participant Information Sheet (see Appendix D) along with a copy of the questionnaire (see Appendix E). Appendix F contains the recruitment script written for the body of the email message sent to the participant group to inform them about the questionnaire and ask them to participate. Choosing to fill out and return the questionnaire confirmed consent to participate. There is no expectation of harm to participants or breach of confidentiality of personal information.

4.1.1 Forensic Sciences Questionnaire. I designed my questionnaire with open-ended questions to allow participants to answer freely with a few contingency questions (Babbie, 2007). The questionnaire consisted of 7 questions or items. The questionnaire began with a general question asking the respondent to discuss any chemicals they previously observed to alter or mask decomposition. The following two questions inquired about specific chemicals including lye and insect repellents. If a respondent acknowledged a specific chemical from the first three questions, then the contingency question inquired about the effects of that chemical. The fourth and fifth questions inquire about chemicals altering postmortem intervals (PMI) or time of death (TOD) estimations and any cases where chemicals were suspected but not proven. To gather the background supporting the respondent's answers, the sixth and seventh questions ask official job title and years of experience.

The targeted population for the questionnaire consisted of forensic pathologists, forensic anthropologists, forensic archaeologists, and death scene investigators in Oklahoma. Table 1 shows the distribution of participants that received the questionnaire. I provided the questionnaire in a Microsoft Word® document for easy editing and administered the questionnaire by email for quick and efficient delivery. I emailed the questionnaire, the recruitment script, Participant

Information Sheet, and the IRB approval to a total of 49 participants within the Office of the Chief Medical Examiner in Oklahoma.

4.1.2 Questionnaire Responses. Upon receipt of questionnaire responses, I downloaded the questionnaire without personal information and saved the responses in a separate file labeled by number according to the order of arrival. After downloading the questionnaire, I double deleted the email containing the responses. News about my questionnaire and study spread, leading to a few individuals approaching me in person to discuss their previous experiences with attempts to alter and mask decomposition. I included these spoken answers with my questionnaire responses. After compiling my questionnaire responses, I carefully read each questionnaire response to create a list of the different attempts to alter or mask decomposition previously observed in Oklahoma criminal cases. Table 2 shows the responses to the questionnaire, the oral responses from outside individuals, and chemicals chosen from my literature review. The highlighted chemicals display the chemicals chosen for my experiment.

Table 2

Questionnaire and Oral Responses of Attempts Taken to Alter and Mask Decomposition

Response	Number of Responses
Ammonia	1
Avon® Skin So Soft**	0
Blankets	1
Bleach	1
Bounce® Dryer Sheets*	1
Burial	1
Coffee*	1
Concrete	1
Copper*	1
DEET Insect Repellent**	0
Febreze®	1
Fire/burning	2
Foliage	1
Lye	2
Muriatic acid	1
Potpourri	1
Vicks® Vapor Rub	1
Water	1

Note. The responses that are highlighted in the chart are the chemicals chosen for my experiment. This includes the two chemicals from the literature review and three chemicals from questionnaire responses.
*Spoken/oral answers from outside questionnaire selected population
**Chemicals chosen from literature review.

The questionnaire responses were not concentrated with multiple observations of the same attempts to alter or mask decomposition. The only responses that had more than one observation were fire/burning and lye. For this study I wanted to focus more on chemicals that were easily obtainable and common in most households. For this reason, I decided not to select responses such as fire, concrete, potpourri, copper, coffee, Vicks® vapor rub, water, burial, foliage, blankets, and Bounce® dryer sheets. From my literature review, I had seen other studies involving lye or lime, as well as bleach. However, there haven't been many studies comparing the effects different chemicals have on decomposition rates. For my experiment, I decided to test five different chemicals to compare their effects on decomposition rates.

4.1.3 Chosen Experiment Chemicals. For my first chemical, I chose bleach because it is a common household chemical and is easily accessible. The second chemical I chose was lye/lime due to having two responses. This chemical appeared to be popular within the literature review because of the widespread belief that lye/lime speeds up decomposition. This common belief about lye/lime could make it a popular choice for criminals to attempt to alter or mask decomposition. The third chemical I chose for my experiment is Febreze®. I had one response for Febreze® from my questionnaires, but I had not found anything in my literature review about the effects of Febreze® on decomposition rates. Since I had not found anything about Febreze® in my literature review, I decided it would be an interesting chemical to test. Febreze® is known for reducing odors for an extended period of time, and I was interested to see if this would deter insects and therefore alter decomposition rates.

I only chose three chemicals from my questionnaire responses due to a limited number of responses and a low number of chemicals reported. Chemicals such as muriatic acid and ammonia were reported as questionnaire responses, but were excluded due to their destructive properties. From the literature review, one chemical that gained interest is N,N-diethyl-meta-toluamide (DEET) and how the application of DEET causes a chain reaction in the process of decomposition. DEET is one of the most common active ingredients in most topical insect repellents on the market. DEET insect repellents are used to deter or repel insects from approaching the surface that it is applied to. With insects being the main facilitator in decomposition, if an insect repellent is applied, then flies may arrive late, delaying colonization and emergence of larvae, ultimately slowing decomposition rates. For this reason, I decided to use a DEET insect repellent as my fourth chemical for my experiment.

My fifth chemical for my experiment is Avon® Skin So Soft body lotion. From the previous studies examined for my literature review, I did not notice any natural remedies included in the studies. Avon® Skin So Soft is commonly believed to act as an insect repellent, therefore

some people tend to use it instead of a DEET insect repellent. I wanted to try to fill a gap within the previous literature and add a more natural remedy to my experiment, and then compare the effects of the natural remedy with the effects of the other common chemicals chosen for my experiment. Overall, the five chosen chemicals to be tested for my experiment based on the questionnaire responses and the literature review included bleach, lye/lime, Febreze®, DEET insect repellent, and Avon® Skin So Soft body lotion.

4.2 Experimental Methodology

The second method in my research consisted of an experiment to test the effects of chemicals on decomposition rates. I used the five chemicals chosen from the questionnaire responses and the literature review to test on animal cadavers. I used feline cadavers for Experiment One and defeathered chicken cadavers for Experiment Two. Feline cadavers were obtained from a local animal control facility and were not euthanized for the purpose of this research. The chicken cadavers were obtained from a retail grocery store. I weighed the cadavers each day between 1100 hours and 1300 hours, as well as photographed and collected daily observations. Daily observations consisted of weather conditions, odor, color, insects, fluids, bloating, and any other noticeable changes to the cadavers. I used the weights of the cadavers to calculate decomposition rates. The decomposition rates from the two experiments provided data for the quantitative analysis in the third method.

This research has been submitted to the Oklahoma State University (OSU) Institutional Animal Care and Use Committee (IACUC) and does not require IACUC approval (see Appendix B and Appendix C). No animals were harmed or killed for the purpose of this study. I completed an articulated ladder safety training course from www.laddersafety.org as required by OSU due to the location of the experiment being on the roof of the Investigative Sciences Research and Teaching Laboratory at Oklahoma State University Center for Health Sciences (OSU-CHS) in

Tulsa, Oklahoma. Appendix H shows my certificate of completion for articulated ladder safety completed on July 25, 2017.

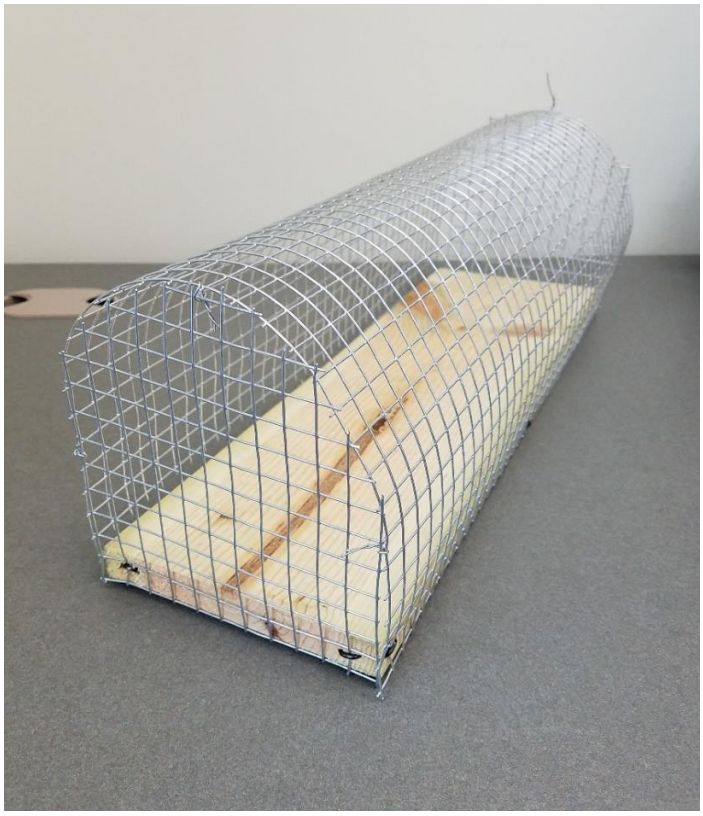
4.3 Experiment One

I conducted Experiment One using feline cadavers due to their availability and smaller size. This experiment consisted of six feline cadavers, one for the control and one for each of the five chemicals selected from the questionnaire responses and literature review. I applied the chosen chemicals to the cadavers and placed them outside on the roof of the Investigative Sciences Research and Teaching Laboratory at Oklahoma State University Center for Health Sciences (OSU-CHS) in Tulsa, Oklahoma to monitor the decomposition process. I collected daily weights, photographs, and observations to provide data for the statistical analysis.

4.3.1 Experiment Materials. The materials needed for Experiment One included six feline cadavers, six cadaver observation cages and rubber bands, a camera, a digital hanging scale, a composition notebook, six laminated tags, a dry erase board and marker, twelve normal weight half concrete blocks, six three-foot Blue Hawk® welded silver steel chains, twelve Blue Hawk® zinc-plated quick links, six Hefty®® EZ Foil Oven Liners (18.25x15.75x0.5 inches), and six rectangles of blue plastic tarp (2ftx3ft). I used these materials for the setup of Experiment One to hold and protect the animal cadavers from the weather and scavengers while leaving easy access to insects. I built the observation cages out of 1x6x18 inch pine-board bases with a curved top made from ½ inch hardware cloth. I treated the pine boards with three applications of polyurethane on all sides and edges to protect the wood from damage during the experiment. The pine board made the base of the cage and I stapled the hardware cloth to the long sides of the pine board to create an arch. I used semicircle cutouts of the hardware cloth to close the ends of the cage and wired them closed (see Figure 2). See Appendix G for detailed instructions.

Figure 2

Built Animal Cadaver Observation Cage



Note. These cages were built to hold and protect the animal cadaver from scavengers during the experiment.

The chemicals I used for this experiment included Great Value® Concentrated Bleach (Bleach Date Code: 18 061 23:12 B1 TX-01) for Cadaver #2, Cutter® Backwoods Insect Repellent (Lot # U110717BC 1227 HG-26283-2) for Cadaver #3, Febreze® Fabric Extra Strength Original Scent Fabric Refresher (Lot # 80811731022127) for Cadaver #4, Avon® Skin So Soft Original Body Lotion (Lot #: (L)MIH71 S1) for Cadaver # 5, and pelletized lawn lime (Lot #: 30 7219 02) for Cadaver #6. I purchased the Cutter® Backwoods Insect Repellent in a twin pack that contained two 11oz aerosol cans. I used the same bottle of Avon® Skin So Soft

Original Body Lotion and the same bag of pelletized lawn lime for Experiment One and Experiment Two. I purchased these specific chemicals due to their affordable prices and accessibility to the public.

I picked up the feline cadavers from a local animal control facility on Tuesday April 17, 2018 at around 0830 hours. The feline cadavers were euthanized on Monday April 16, 2018 around 0900 hours and were not euthanized for the purpose of this research. No consideration was made for the chemicals used to euthanize the cadavers. The feline cadavers were semi-frozen and placed in one bag together. I returned to the Investigative Sciences Research and Teaching Laboratory and placed the bag of feline cadavers in the vent hood to thaw.

4.3.2 Experiment Preparation and Location. I began the setup of my experiment on Wednesday April 18, 2017 around 1230 hours. I removed my feline cadavers from the vent hood at the Investigative Sciences Research and Teaching Laboratory at OSU-CHS. I worked outside in the parking lot of the Investigative Sciences Research and Teaching Laboratory under tree shade. I measured each cadaver observation cage three times with a digital hanging scale to better validate my instrument and look for any error in weighing techniques. I then averaged the weights of each cadaver cage to determine the weight of the cage that I would use for my experiment to calculate the weight of the feline cadaver (see Table 3).

Table 3

Experiment One Averaged Observation Cage Weights

Cage	Weight 1 (lbs.)	Weight 2 (lbs.)	Weight 3 (lbs.)	Average (lbs.)
1	1.83	1.80	1.80	1.81
2	1.72	1.73	1.75	1.73
3	1.74	1.72	1.71	1.72
4	1.82	1.83	1.83	1.83
5	1.79	1.79	1.80	1.79
6	1.79	1.80	1.79	1.79

I then unwired one end of each observation cage to open the cage so that I could place an animal cadaver inside. I photographed each feline cadaver before placing them inside the cages. I then placed one feline cadaver in each observation cage and wired the cage closed again. I used the digital hanging scale to weigh each observation cage with the feline cadaver inside to get the initial weight of the animal cadaver before chemical application. After weighing each cadaver and observation cage, I assigned each cadaver a chemical. The cadaver numbers and chemicals were chosen at random. I then applied the chemicals to the assigned animal cadaver.

Cadaver 1 was assigned to be the control cadaver for the experiment, therefore no chemicals were applied. I assigned Bleach to Cadaver 2. I decided to apply the entire bottle of bleach because I suspected that a criminal offender might approach the situation in that way. I poured the full bottle of bleach (121 fl. oz.) directly on the cadaver through the hardware cloth from the top of the observation cage to ensure that I fully coated the animal cadaver with the chemical. It appeared that the fur on the feline cadaver soaked up some of the bleach. I assigned DEET insect repellent to Cadaver 3. I decided to apply the entire aerosol can of insect repellent to ensure that the animal cadaver was fully coated, and I suspected that a criminal offender would

apply as much of the chemical in possession as possible. I sprayed the entire aerosol can of DEET insect repellent (11 oz.) directly on the cadaver through the hardware cloth from the top of the observation cage. It appeared that the fur on Cadaver 3 absorbed or soaked up some of the DEET insect repellent.

I assigned Febreze® to Cadaver 4. I decided to purchase the biggest bottle of Febreze® that I could to ensure the animal cadaver was fully coated, and I suspected that a criminal offender would apply as much Febreze® as possible. I poured the entire bottle of Febreze® (67.6 fl. oz.) directly on Cadaver 4 through the hardware cloth from the top of the observation cage. It appeared that the fur on Cadaver 4 absorbed or soaked up some of the Febreze®. I assigned Avon® Skin So Soft original body lotion to Cadaver 5. To apply the lotion to Cadaver 5, I unwired the observation cage and removed Cadaver 5 from the cage. I placed Cadaver 5 on one of the foil oven liners and started with 0.25 cups of lotion. I put gloves on and rubbed the body lotion all over Cadaver 5. I added an additional 0.25 cups of lotion to equal a total of 0.50 cups of lotion applied to Cadaver 5 to ensure that the cadaver was fully coated. I then placed Cadaver 5 back into the cadaver observation cage and wired the cage closed.

I assigned pelletized lawn lime to Cadaver 6. I bought a large 40lb bag of pelletized lawn lime from a local retail store due to the large amount, accessibility, and affordable price because I suspected that that is how a criminal offender would approach the situation. I started with 1.00 cup of pelletized lawn lime and poured it directly on Cadaver 6 through the hardware cloth from the top of the observation cage. I then added 2.00 more cups of pelletized lawn lime to ensure that the animal cadaver was fully covered. However, the wind was blowing, and the pelletized lawn lime had a consistency similar to soil and therefore some pelletized lawn lime blew or fell out of the cadaver observation cage during the setup of the experiment.

After I applied the chemicals to the assigned animal cadavers, I used the digital hanging scale to weigh each animal cadaver and observation cage to record the new initial weight after applying the chemical. This new weight would be used to calculate the weight of the animal cadaver to observe the process of decomposition. Table 4 shows the weight of the animal cadaver and observation cage before the chemical was applied, the weight after the chemical was applied, and the amount of the chemical applied. I made laminated tags containing the cadaver number and the assigned chemical and then attached the labels to the observation cages with rubber bands.

Table 4

Weight of Animal Cadaver & Observation Cage Before and After Application of Chemical – Experiment One

Cadaver	Assigned Chemical	Amount of Chemical	Weight Before (lbs.)	Weight After (lbs.)
1	Control	N/A	6.50	N/A
2	Bleach	121 fl. Oz.	6.60	6.79
3	DEET	11 oz.	9.15	9.34
4	Febreze®	67.6 fl. Oz.	10.55	10.70
5	Avon®	0.5 cups	6.88	7.09
6	Pelletized Lawn Lime	3 cups	8.09	9.05

Note. The amount of chemical listed for Bleach, DEET, and Febreze® were the amounts provided on the container from the manufacturer. The amount of chemical listed for Avon® and Pelletized lawn lime are amounts that I measured that appeared to be reasonable and completely covered the cadaver.

After I finished preparing the animal cadavers, I prepared the cutouts of blue plastic tarp to cover the cadaver cages. I bought a 9 ft x12 ft blue plastic tarp from a local retail store and cut out six rectangles about 2ft x 3ft. I then proceeded to move all of the experiment materials to the roof of the Investigative Sciences Research and Teaching Laboratory. I used a 12-foot wooden step ladder that I stored inside the Investigative Sciences Research and Teaching Laboratory to access the roof. I carried the ladder outside to the parking lot every day and then carried it back

inside to store it when not in use. I used the wooden step ladder to place the 12 normal weight half concrete blocks, six Blue Hawk® welded silver steel chains, 12 Blue Hawk® zinc-plated quick links, six foil oven liners, and six blue plastic tarp rectangles atop the roof. I then carried the six observation cages containing the animal cadavers to the roof.

Once the materials were on the roof, I began to space them out along the roof to set up the experiment. Each cadaver was placed on top of two normal weight half concrete blocks. I spaced the pairs of concrete blocks around the roof so that the cadavers were not too close to each other to prevent interference with one another. I placed the two concrete blocks next to each other and then I looped a Blue Hawk® welded silver steel chain through the openings in the concrete blocks that would later attach to the cadaver observation cage. I placed one short side of the tarp rectangle under one side of the concrete blocks so that the tarp could be draped over the top of the observation cage and tucked under the opposite side of the concrete blocks as an anchor. I then placed one foil oven liner on top of each pair of concrete blocks and placed an observation cage on top of the foil oven liner.

I used a Blue Hawk® zinc-plated quick link to attach each end of the Blue Hawk® welded silver steel chain to opposite corners of the observation cage to anchor the cage to the concrete blocks. I then folded the tarp across the top of the observation cage and tucked the loose end of the tarp under the concrete blocks. I chose to cover my observation cages to protect my cadavers from environmental factors such as the rain to keep my data reliable. Since I used animal cadavers with fur, I did not want the fur to absorb rain and then make my weight datum unreliable for analysis. The tarps still allowed insects easy access to the observation cages from the sides. Figure 3 shows an observation cage anchored to the concrete blocks and covered by a tarp to demonstrate the setup of my experiment for each of the six animal cadavers. Figure 4 shows the placement of the six animal cadaver observation cages across the roof of the Investigative Sciences Research and Teaching Laboratory at OSU-CHS.

Figure 3

Animal Cadaver Observation Cage Set Up for Experiment One

Note. These cages were built to hold and protect the animal cadaver from scavengers. The chains and concrete blocks were included to anchor the observation cages to prevent scavengers from moving the cages. The tarps were included to protect the cadavers from environmental factors to maintain reliable data.

Figure 4

Placement of Animal Cadaver Observation Cages for Experiment One

Note. The cages were spaced out to prevent interference with each other.

Once the experiment was set up, I used the ladder to climb down from the roof. I then carried the ladder back inside the Investigative Sciences Research and Teaching Laboratory where I stored the ladder when not in use. I established a block of time between 1100 hours and 1300 hours every day to return to my experiment and record daily observations.

4.3.3 Experiment Observations. I returned daily between 1100 hours and 1300 hours to check on my experiment and collect daily observations. I collected daily weights, photographs, and observations to provide data for the statistical analysis. Every day when I arrived at the Investigative Sciences Research and Teaching Laboratory, I carried my ladder outside and set it up in the parking lot to access the roof. The first thing I did when I accessed the roof was uncover all six of my animal cadavers by untucking one end of the blue tarp and unhook the Blue Hawk® zinc-plated quick links from the cadaver cage so that I could weigh the cadavers. I used a composition notebook to record my observations. I used the Weather Channel App to record the weather conditions in Tulsa, Oklahoma each day. I included the current temperature, daily high and low temperatures, humidity, dew point, pressure, UV index, precipitation, wind, and weather conditions.

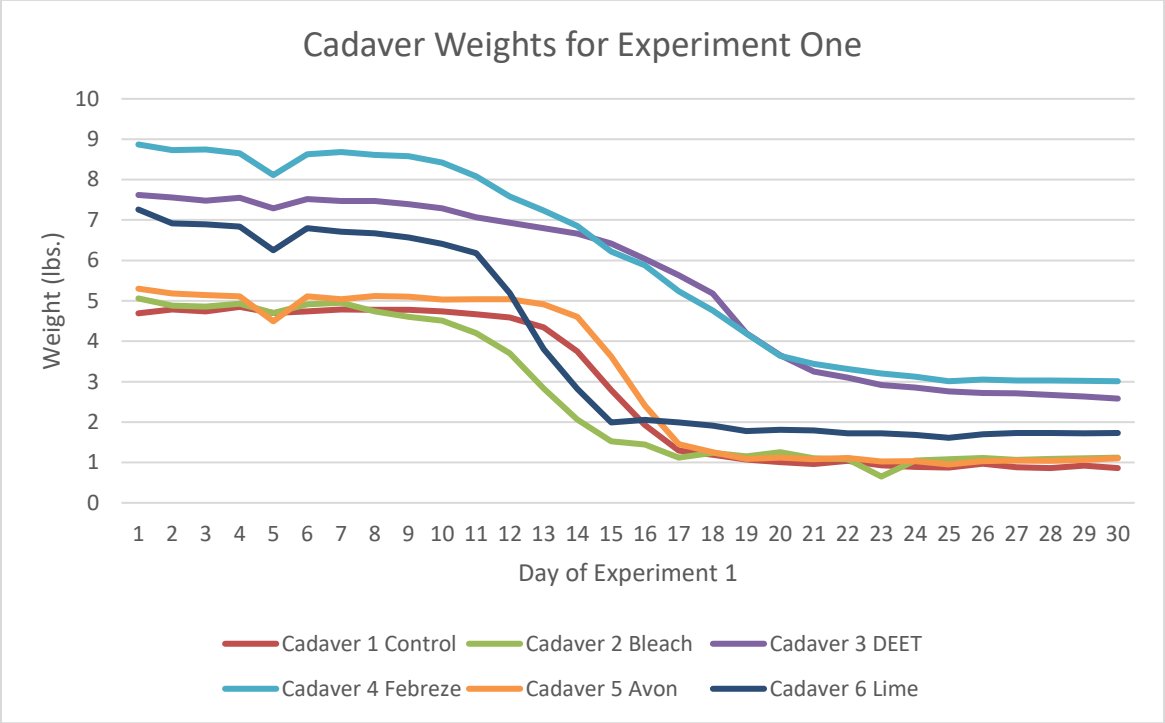
I recorded the time that I began weighing the animal cadavers and observation cages. I used a digital hanging scale to weigh each animal cadaver and observation cage. I recorded the weight of each cadaver in my composition notebook. After weighing the cadavers, I reconnected the Blue Hawk® zinc-plated quick links to the cadaver cages to anchor the cages back down. After anchoring the cages, I photographed the cadavers from a minimum of three angles. I photographed the animal cadaver from along both long sides (18in) of the observation cages and then from the top to get a bird's eye view. I included a dry erase board in the first photograph to identify the animal cadaver, the chemical involved, the date, and the time I started taking photographs. If there were noticeable changes to the animal cadaver, I took close up photographs to document the changes to the cadaver to record the decomposition process and wrote the

observations down in my composition notebook. Once I completed photographs on all six cadavers, I recovered the observation cages by draping the blue tarps back over the top of the observation cages and tucking the loose end of the tarp under the concrete blocks (see Figure 3). Once all cadavers and observation cages were anchored and covered, I descended from the roof and stored my ladder back inside the Investigative Sciences Research and Teaching Laboratory until I returned the following day.

4.3.4 Experiment Data. After reviewing previous studies, I performed the experiment until the point that the weights of the animal cadavers began to plateau. The first animal cadaver to start plateauing was Cadaver 6 – lime around day 15 and the last animal cadaver to start plateauing was Cadaver 3 – DEET around day 23. I wanted to ensure that each animal cadaver was able to plateau for a few days before ending the experiment to confirm that the weight had actually plateaued. Since the last animal cadaver started to plateau around day 22, I decided to end Experiment One on day 30. Performing the experiment for a full 30 days allowed all of the animal cadaver weights to plateau and most of the insects had disappeared. Figure 5 provides a graph that illustrates the change in weight for all six animal cadavers compared to each other and to show the plateau of the animal cadaver weights.

Figure 5

Change in Animal Cadaver Weights for Experiment One



In Figure 5, there is an outlier in the datum for day five of Experiment One. It rained on day four of Experiment One causing all of my equipment to get wet. My digital hanging scale had gotten wet while trying to weigh the animal cadavers on day four. Some of the rain moisture was visible inside the digital hanging scale monitor and I believe it led to some calibration issues. The moisture in the digital hanging scale led to the animal cadaver weights on day five to be significantly different than day four. On the evening of day five, I removed the batteries from the digital hanging scale and left the back off the scale over night to air dry to hopefully fix the calibration issues. On day six the digital hanging scale appeared to be dry and the animal cadaver weights had returned to weights consistent with day four. Therefore, I believe issues with the digital hanging scale caused an outlier in the weight datum for day five.

When I arrived at my experiment daily, I recorded the weather conditions in my composition notebook. This included the current temperature, daily high and low temperatures,

humidity, dew point, pressure, UV index, precipitation, wind, and conditions from the Weather Channel App. I recorded the weather conditions because the weather, especially temperature, can affect decomposition processes and decomposition rates. If the temperature is warmer, then decomposition processes can speed up. If the temperature is cooler, then decomposition processes may slow down. In order to document every factor possible that could affect the decomposition rates and processes for my animal cadavers in my experiment, I included all available details about the weather conditions for each day. Table 5 shows the weather conditions for Experiment One.

Table 5

Experiment One Weather Conditions

Day	Date	Time	Current Temp	High Temp	Low Temp	Humidity	Dew Point	Pressure	UV Index	Prec.	Wind	Conditions
1	4/18/18	1545	63°F	69°F	40°F	39%	37°F	30.02 in	6 High	0%	NW 15 mph	Windy/Sunny
2	4/19/18	1230	56°F	61°F	41°F	41%	32°F	30.43 in	7 High	0%	N 10 mph	Windy/Sunny
3	4/20/15	1225	59°F	66°F	47°F	39%	34°F	30.33 in	8 Very high	0%	SE 12 mph	Windy/sunny
4	4/21/18	1225	49°F	54°F	48°F	85%	44°F	30.09 in	3 Moderate	95%	NE 8 mph	Raining
5	4/22/18	1225	52°F	55°F	51°F	82%	47°F	30.01 in	3 Moderate	0%	NW 9 mph	Cloudy/windy
6	4/23/18	1225	65°F	73°F	49°F	56%	49°F	30.06 in	8 Very high	0%	N 11 mph	Sunny/light breeze
7	4/24/18	1225	75°F	78°F	52°F	25%	37°F	30.09 in	8 Very high	0%	N 7 mph	Sunny/light breeze
8	4/25/18	1225	56°F	57°F	44°F	83%	50°F	30.13 in	3 Moderate	70%	W 7 mph	Raining/cloudy
9	4/26/18	1226	57°F	69°F	50°F	68%	46°F	30.01 in	3 Moderate	0%	NNE 6 mph	Partly cloudy/light breeze
10	4/27/18	1225	67 °F	75 °F	50 °F	28%	33 °F	30.09 in	8 Very high	0%	NNW 8 mph	Sunny/light breeze
11	4/28/18	1201	74 °F	79 °F	55 °F	35%	45 °F	30.07 in	7 High	0%	N 6 mph	Sunny/light breeze
12	4/29/18	1155	73 °F	79 °F	59 °F	40%	47 °F	30.14 in	7 High	0%	SE 13 mph	Sunny/light breeze
13	4/30/18	1240	79 °F	83 °F	65 °F	35%	49 °F	30.02 in	8 Very high	0%	S 22 mph	Sunny/windy
14	5/1/18	1116	73 °F	80 °F	69 °F	68%	61 °F	29.91 in	1 Low	15%	S 16 mph	Cloudy/windy
15	5/2/18	1230	74 °F	83 °F	69 °F	74%	65 °F	29.96 in	4 Moderate	20%	SSE 6 mph	Cloudy/ light breeze
16	5/3/18	1230	66 °F	81 °F	60 °F	85%	62 °F	29.87 in	7 High	20%	SSE 11 mph	Mostly Cloudy
17	5/4/18	1230	65 °F	76 °F	54 °F	66%	54 °F	30.02 in	7 High	10%	N 3 mph	Mostly Cloudy
18	5/5/18	1115	76 °F	83 °F	59 °F	40%	50 °F	30.13 in	6 High	0%	NW 5 mph	Sunny
19	5/6/18	1118	83 °F	90 °F	62 °F	30%	48 °F	30.08 in	6 High	0%	SW 11 mph	Sunny
20	5/7/18	1123	86 °F	91 °F	67 °F	38%	57 °F	30.11 in	6 High	0%	SE 3 mph	Sunny
21	5/8/18	1100	84 °F	92 °F	69 °F	59%	57 °F	29.93 in	3 Moderate	0%	S 13 mph	Sunny
22	5/9/18	1242	89 °F	93 °F	68 °F	37%	60 °F	29.90 in	9 Very High	0%	SSW 5 mph	Sunny
23	5/10/18	1218	82 °F	86 °F	68 °F	43%	57 °F	29.93 in	8 Very high	0%	S 17 mph	Partly Cloudy
24	5/11/18	1213	79 °F	86 °F	70 °F	54%	61 °F	29.82 in	8 Very high	20%	S 22 mph	Partly Cloudy/Windy
25	5/12/18	1251	82 °F	86 °F	69 °F	58%	65 °F	29.90 in	7 High	0%	S 16 mph	Mostly Cloudy
26	5/13/18	1226	85 °F	90 °F	71 °F	50%	64 °F	29.95 in	9 Very High	0%	S 16 mph	Sunny
27	5/14/18	1229	87 °F	89 °F	67 °F	48%	65 °F	29.88 in	9 Very High	0%	S 14 mph	Sunny
28	5/15/18	1225	78 °F	85 °F	66 °F	61%	64 °F	29.94	8 Very high	20%	WNW 8 mph	Partly Cloudy
29	5/16/18	1245	69 °F	82 °F	64 °F	80%	63 °F	29.94 in	6 High	90%	SW 6 mph	Cloudy/ Light rain (not raining during
30	5/17/18	1248	83 °F	86 °F	63 °F	47%	61 °F	29.92 in	7 High	0%	NW 4 mph	Sunny/ Parly Cloudy

After recording the weather conditions, I weighed the animal cadavers daily. I did not remove the animal cadavers from the cage to weigh them because it would provide unreliable results due to not being able to weigh the decomposition fluids and matter left inside the observation cage. I weighed each observation cage at the beginning of the experiment so that I would be able to weigh the animal cadaver inside the cage and then calculate the weight of the animal cadaver alone. I created a table for each animal cadaver that contained the day of the experiment, date, time, weight of the observation cage, weight of the animal cadaver and the observation cage, the weight of the animal cadaver alone, and the change in weight of the animal cadaver from day to day. Decomposition rates for each animal cadaver were calculated to be used in the statistical analysis. Table 6 shows the animal cadaver weight table for Cadaver 1 assigned to be the control. A similar table was made for each animal cadaver. See Appendix J for the animal cadaver weight tables for Cadavers 2 through 6.

Table 6

Animal Cadaver Weight Table – Cadaver 1 Control – Experiment One

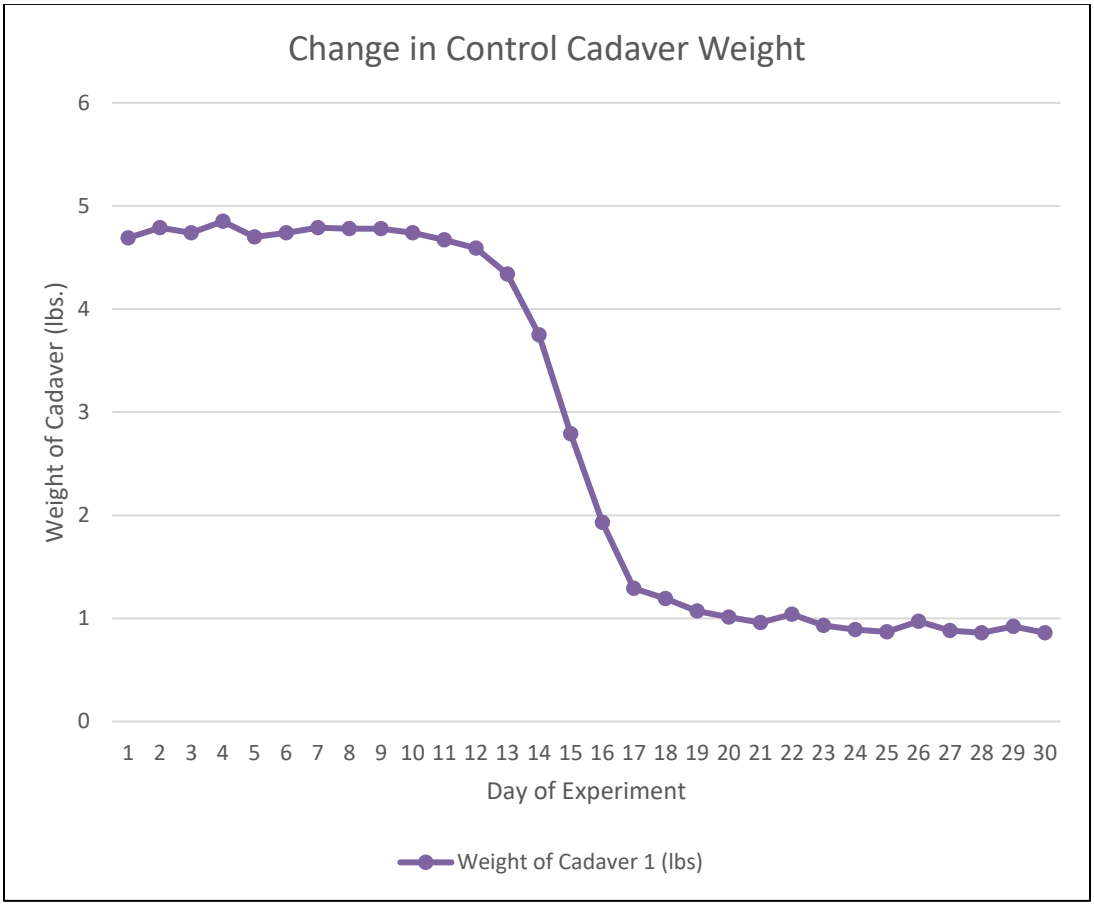
Day	Date	Time	Weight of Cage (lbs.)	Weight of Cadaver & Cage (lbs.)	Weight of Cadaver (lbs.)	Change (lbs.)
1	4/18/18	1545	1.81	6.50	4.69	
2	4/19/18	1230	1.81	6.60	4.79	0.10
3	4/20/18	1225	1.81	6.55	4.74	-0.05
4	4/21/18	1225	1.81	6.66	4.85	0.11
5	4/22/18	1225	1.81	6.51	4.70	-0.15
6	4/23/18	1225	1.81	6.55	4.74	0.04
7	4/24/18	1225	1.81	6.60	4.79	0.05
8	4/25/18	1225	1.81	6.59	4.78	-0.01
9	4/26/18	1226	1.81	6.59	4.78	0.00
10	4/27/18	1225	1.81	6.55	4.74	-0.04
11	4/28/18	1201	1.81	6.48	4.67	-0.07
12	4/29/18	1155	1.81	6.40	4.59	-0.08
13	4/30/18	1240	1.81	6.15	4.34	-0.25
14	5/1/18	1116	1.81	5.56	3.75	-0.59
15	5/2/18	1230	1.81	4.60	2.79	-0.96
16	5/3/18	1230	1.81	3.74	1.93	-0.86
17	5/4/18	1230	1.81	3.10	1.29	-0.64
18	5/5/18	1115	1.81	3.00	1.19	-0.10
19	5/6/18	1118	1.81	2.88	1.07	-0.12
20	5/7/18	1123	1.81	2.82	1.01	-0.06
21	5/8/18	1100	1.81	2.77	0.96	-0.05
22	5/9/18	1242	1.81	2.85	1.04	0.08
23	5/10/18	1218	1.81	2.74	0.93	-0.11
24	5/11/18	1213	1.81	2.70	0.89	-0.04
25	5/12/18	1251	1.81	2.68	0.87	-0.02
26	5/13/18	1226	1.81	2.78	0.97	0.10
27	5/14/18	1229	1.81	2.69	0.88	-0.09
28	5/15/18	1225	1.81	2.67	0.86	-0.02
29	5/16/18	1245	1.81	2.73	0.92	0.06
30	5/17/18	1248	1.81	2.67	0.86	-0.06

No consideration was made for any changes in weight of the observation cages. The pine board base was treated with polyurethane to protect the wood, but the pine base could have been altered or warped by external factors such as heat and humidity. Alterations to the pine board could cause changes in the weight of the cage and therefore alter the calculated weight of the animal cadavers. Also, no consideration was made for the weight of insects, including eggs and maggot swarms, on the animal cadavers' weights. The weight of any insects was considered part of the animal cadaver weight.

Throughout the process of the experiment, I graphed the animal cadaver weight for each cadaver to monitor the decline in weight. I graphed the animal cadaver weight to determine when the decomposition process of each individual animal cadaver began to plateau. I determined the length of my experiment on the plateau of the animal cadaver weights. Figure 6 shows a graph of the change in weight for animal cadaver 1 assigned as the control. Each graph for the six different animal cadavers and chemicals were combined to compare the change in weight of all six cadavers in one graph as seen in Figure 5. See Appendix K for the change in animal cadaver weight graphs for cadavers 2 through 6.

Figure 6

Change in Control Cadaver Weight – Experiment One



Besides the weather conditions and the weight of the animal cadavers, I also photographed the animal cadavers daily to record the visual decomposition changes so that I could compare these changes after experiment completion. I photographed each cadaver a minimum of three times. The first photograph included the dry erase board with the cadaver number, chemical, date, and time I started photographing the cadavers. This photograph was taken along one long side (18in) of the animal cadaver observation cage. I then photographed the cadaver from the top to get a bird's eye view of the animal cadaver. The third photograph was taken from the opposite long side (18in) of the animal cadaver observation cage from the first photograph. I photographed the animal cadavers this way to include both visible sides and the top

of the animal cadaver. In addition to these three photographs, I would photograph anything of interest or any changes that I noticed from the previous day. Items of interest included maggots, fluids, color change, bloating, other insects, or anything else that appeared throughout my experiments. Figure 7 shows the minimum three photographs that I obtained on each individual animal cadaver daily.

Figure 7

Minimum Three Photographs of Each Animal Cadaver Taken Daily – Experiment One

Note. These three pictures represent the minimum three pictures taken of each cadaver daily. This is Cadaver 1 – Control on Day 7 of Experiment One.

Photographing the animal cadavers at the same time daily for the duration of the experiment allowed me to compare the visible differences in decomposition rates and processes

between animal cadavers after being treated with different chemicals after experiment completion. Examining the animal cadavers daily made it difficult to notice every change that occurred to the animal cadavers. If you look at something constantly or every day, it can be difficult to notice every small change that occurs. Looking at the photographs after experiment completion provided evidence of the changes that occurred from day to day. See Appendix M for photographs of all six animal cadavers from Experiment One. Over 600 photographs were obtained for Experiment One. Additional photographs may be obtained upon request.

After I completed photographs, I recorded observations in my composition notebook. Daily observations included odor, bloating, fluids, flies, maggots, beetles, other insects, and other obesrvations and notes. These observations provided useful information including when odor, bloating, and fluids became present; when flies, maggots, beetles, or other insects became present and the quantity; and other observations including fur loss, visible bones, appearance, and surroundings. I wrote down these observations daily for each individual animal cadaver and then recorded them within a table for each animal cadaver. Table 7 shows the animal cadaver observations table for Cadaver 1 assigned as the control for Experiment One. See Appendix L for the animal cadaver observations tables for Cadavers 2 through 6.

Table 7

Animal Cadaver Observations Table – Cadaver 1 Control – Experiment One

Day	Date	Odor	Color	Bloating	Fluid	Flies	Maggots	Beetles	Other insects	Other Observations/notes
1	4/18/18	none	none	none	none	none	none	none	none	none
2	4/19/18	none	none	none	none	none	none	none	none	none
3	4/20/18	none	none	none	none	none	none	none	none	none
4	4/21/18	none	none	none	none	none	none	none	none	none
5	4/22/18	none	none	none	none	none	none	none	none	none
6	4/23/18	none	none	none	none	none	none	none	none	none
7	4/24/18	none	none	none	none	few	none	none	none	none
8	4/25/18	none	none	none	none	none	none	none	none	Possible insects inside cadaver?
9	4/26/18	none	none	none	none	none	none	none	none	Possible insects inside cadaver?
10	4/27/18	none	none	none	none	Several	none	none	none	none
11	4/28/18	slight	none	none	none	several	none	none	none	none
12	4/29/18	slight	none	slightly	none	few	few	none	none	tiny maggots near face, loss of fur
13	4/30/18	slight	none	deflated	none	few	none	one	none	Maggots may have been inside cadaver so not noticeable
14	5/1/18	slight	none	deflated	none	none	several	none	none	maggots in mouth and under cage
15	5/2/18	slight	none	deflated	none	none	several	none	none	maggots crawling through fur, loss of fur
16	5/3/18	strong	none	deflated	none	none	several	none	none	several maggots on cadaver, under cage, and on ground, loss of fur
17	5/4/18	strong	none	deflated	none	none	several	none	none	several maggots on cadaver, under cage, and on ground, loss of fur
18	5/5/18	slight	none	deflated	none	none	none	none	none	no visible maggots on cadaver, maggots under cage and on tarp, loss of fur
19	5/6/18	slight	none	deflated	none	none	none	none	none	no visible maggots on cadaver, maggots under cage, loss of fur
20	5/7/18	none	none	deflated	none	none	none	none	none	no visible maggots, no noticeable odor, loss of fur
21	5/8/18	none	none	deflated	none	none	none	none	none	Maggots under the cage, loss of fur
22	5/9/18	none	none	deflated	none	none	none	none	none	more fur gathering on carcass, eye sockets drying out, skin on nose and forehead visible
23	5/10/18	none	none	deflated	none	few	none	none	none	loss of fur, several flies on ground under tarp, flew away when tarp removed
24	5/11/18	none	none	deflated	none	none	none	none	none	flies dying under tarp and blocks, fur loss, a few lethargic flies flew out from under cinderblocks
25	5/12/18	none	none	deflated	none	none	none	none	none	dead flies on tarp
26	5/13/18	none	none	deflated	none	none	none	none	none	dead flies on tarp
27	5/14/18	none	none	deflated	none	none	none	none	none	loose fur on cadaver, no new changes
28	5/15/18	none	none	deflated	none	few	none	none	none	loose fur on cadaver, letharic flies flew up from tarp, possible showers overnight
29	5/16/18	none	none	deflated	none	none	none	none	none	loose fur on cadaver, no new changes
30	5/17/18	none	none	deflated	none	none	none	none	none	lots of loose fur in cage, Removal of cadaver: all fur detached from bottom, skin dried and gone, could see clean bones

4.4 Experiment Two

For Experiment Two, I used defeathered chickens instead of feline cadavers. My literature review provided evidence that fur on animals, such as rabbits and cats, can alter the process of decomposition by causing insects to work from the inside out. I observed this in Experiment One with the feline cadavers. I also experienced a delay with receiving my second round of feline cadavers. After speaking with my committee, we chose to use defeathered chickens for Experiment Two. Using chickens solved the delay that I experienced receiving the second round of feline cadavers, but it also provided a way to show the difference between decomposition on animal cadavers with fur and without fur with the same chemicals from Experiment One. This experiment consisted of six defeathered chicken cadavers, one for the control and one for each of the five chemicals selected from the questionnaire responses and literature review. I applied the chosen chemicals to the cadavers and placed them outside on the roof of the Investigative Sciences Research and Teaching Laboratory at Oklahoma State University Center for Health Sciences (OSU-CHS) in Tulsa, Oklahoma to monitor the decomposition process. I collected daily weights, photographs, and observations to provide data for the statistical analysis.

4.4.1 Experiment Materials. I used some of the same materials from Experiment One for Experiment Two. The materials that I reused for Experiment Two included the six cadaver observation cages, a camera, a digital hanging scale, a composition notebook, six laminated tags and rubber bands, a dry erase board and marker, twelve normal weight half concrete blocks, six three-foot Blue Hawk® welded silver steel chains, twelve Blue Hawk® zinc-plated quick links, and six rectangles of blue plastic tarp (2ftx3ft). I decided to purchase new aluminum full-size deep steam pans to place my cadavers in because the foil oven liners I used for Experiment One were dirty and I suspected that the defeathered chickens would create more fluid than the feline cadavers. I bought six Aluminum Mainstays® Full-Size Deep Steam Pans (20.5x13x3 inches)

from a local retail store. I used these materials for the setup of Experiment Two to hold the animal cadavers and protect the animal cadavers from the weather and scavengers while leaving easy access to insects, same as Experiment One.

At the end of Experiment One, I cleaned the animal cadaver observation cages. I removed any hair, fluids, and decompositional matter from the cages to ensure that the first experiment wouldn't interfere with the second experiment. I made sure to use the same cage from Experiment One for the same chemical in Experiment Two to prevent any remnants of chemicals mixing with a different chemical. The animal cadaver observation cages were not spotless and still had some decompositional matter left on the wood. No consideration was made for the remaining decompositional matter from Experiment One in Experiment Two.

The chemicals I used for this experiment included Great Value® Concentrated Bleach (Bleach Date Code: 18 121 07:54 B1 TX-01) for Cadaver #2, Cutter® Backwoods Insect Repellent (Lot # U110717BC 1222 HG-26283-2) for Cadaver #3, Febreze® Fabric Extra Strength Original Scent Fabric Refresher (Lot # 81031731021957) for Cadaver #4, Avon® Skin So Soft Original Body Lotion (Lot #: (L)MIH71 S1) for Cadaver # 5, and Pelletized Lawn Lime (Lot #: 30 7219 02) for Cadaver #6. I purchased the Cutter® Backwoods Insect Repellent in a twin pack that contained two 11oz aerosol cans. I used the same bottle of Avon® Skin So Soft Original Body Lotion and the same bag of Pelletized Lawn Lime from Experiment One for Experiment Two. I purchased these specific chemicals due to their affordable prices and accessibility to the public.

I picked up the defeathered chicken cadavers from a local retail grocery store on Sunday May 20, 2018 at around 1030 hours. I chose Tyson® Premium Fresh Young Chickens that are all natural, with no added hormones or steroids, and are sourced only from the US. The ingredients included chicken broth, sea salt, and natural flavorings. All six defeathered chicken cadavers had

a sell by date of May 27, 2018 with a product manufacturing number of PM# 99044469/605705 609805. No consideration was made for the processing of the grocery store chickens. The defeathered chicken cadavers were semi-frozen and individually wrapped in plastic. The defeathered chicken cadavers had the necks removed and had the heart, liver, and gizzards wrapped in butcher paper inside the chicken. I returned to the Investigative Sciences Research and Teaching Laboratory to immediately set up Experiment Two.

4.4.2 Experiment Preparation and Location. I began the setup of my experiment on Sunday May 20, 2018 around 1130 hours at the Investigative Sciences Research and Teaching Laboratory at OSU-CHS. I worked outside in the parking lot of the Investigative Sciences Research and Teaching Laboratory under tree shade. I measured each cadaver observation cage three times with a digital hanging scale, the same way I did for Experiment One. I then averaged the weights of each cadaver cage to determine the weight of the cage that I would use for my experiment to calculate the weight of the defeathered chicken cadaver (see Table 8). The weight of all six observation cages remained consistent all three times I weighed them, however, the weights had changed from the weight calculated in Experiment One.

Table 8

Experiment Two Averaged Observation Cage Weights

Cage	Weight 1 (lbs.)	Weight 2 (lbs.)	Weight 3 (lbs..)	Average (lbs.)
1	1.85	1.85	1.85	1.85
2	1.76	1.76	1.76	1.76
3	1.82	1.82	1.82	1.82
4	1.88	1.88	1.88	1.88
5	1.77	1.77	1.77	1.77
6	1.81	1.81	1.81	1.81

I then unwired one end of each observation cage to open the cage so that I could place an animal cadaver inside. I removed the butcher paper containing the heart, liver, and gizzards from inside each chicken and then placed one defeathered chicken cadaver in each observation cage and wired the cage closed again. I used the digital hanging scale to weigh each observation cage with the chicken cadaver inside to get the initial weight of the animal cadaver before chemical application. After weighing each cadaver and observation cage, I applied the chemicals to the assigned animal cadaver. I kept the animal cadaver assignments the same as Experiment One to keep the cadaver numbers and chemicals the same. Since Experiment Two was a replication of Experiment One, I applied the same amount of chemicals to the defeathered chicken cadavers as I did to the feline cadavers in Experiment One. The cadaver numbers and chemical assignments were chosen at random.

Cadaver 1 was assigned to be the control cadaver for the experiment, therefore no chemicals were applied. I assigned Bleach to Cadaver 2. I applied the entire bottle of bleach (121 fl. oz.) to remain consistent with Experiment One. I poured the bleach directly on the cadaver through the hardware cloth from the top of the observation cage to ensure that I fully coated the animal cadaver with the chemical. The defeathered chicken did not absorb or soak up the bleach the same as the feline cadaver. There was no fur or feathers on the chicken to absorb or soak up any of the bleach, so it appeared to run off the chicken cadaver. I assigned DEET insect repellent to Cadaver 3. I applied the entire aerosol can (11 oz.) of insect repellent to remain consistent with Experiment One. I sprayed the DEET insect repellent directly on the cadaver through the hardware cloth from the top of the observation cage. The DEET insect repellent seemed to bubble up or foam on the skin of the defeathered chicken. There was no fur or feathers present to soak up the insect repellent. Once an abundant amount of DEET insect repellent was applied, the insect repellent appeared to bead up and run off the chicken cadaver.

I assigned Febreze® to Cadaver 4. I purchased another bottle of the same type of Febreze® as Experiment One to remain consistent between experiments. I poured the entire bottle of Febreze® (67.6 fl. oz.) directly on Cadaver 4 through the hardware cloth from the top of the observation cage. The Febreze® appeared to run off of the chicken cadaver due to no feathers or fur to soak up the Febreze®. I assigned Avon® Skin So Soft original body lotion to Cadaver 5. To apply the lotion to Cadaver 5, I unwired the observation cage and removed Cadaver 5 from the cage. I placed Cadaver 5 inside an aluminum full-size deep steam pan and applied 0.50 cups of lotion to remain consistent with Experiment One. I put gloves on and rubbed the body lotion all over Cadaver 5. I then placed Cadaver 5 back into the cadaver observation cage and wired the cage closed. The Avon® lotion appeared to mix in with the fur of the feline cadaver from Experiment One and slicked the fur down. However, with the defeathered chicken cadaver, there was no fur or feathers to mix with. The lotion was layered on the defeathered chicken and was not soaked up or absorbed.

I assigned lime to Cadaver 6. I used the same large 40lb bag of pelletized lawn lime that I bought from a local retail store for Experiment One. In preparation for Experiment One, some pelletized lawn lime had fallen off of feline cadaver 6 due to the wind and transportation from the parking lot to the roof of the Investigative Sciences Research and Teaching Laboratory. Therefore, in preparation for Experiment Two, I decided to apply the pelletized lawn lime to the chicken cadaver once I was on the roof of the Investigative Sciences Research and Teaching Laboratory so as not to lose any pelletized lawn lime. I applied 3.00 cups of pelletized lawn lime to the chicken cadaver to remain consistent with Experiment One. The chicken cadaver came wrapped in plastic with fluids, therefore, the cadaver was wet and had moisture on the outside and inside of the chicken cadaver. Once I applied the pelletized lawn lime, it appeared to stick to the chicken cadaver due to the moisture. The pelletized lawn lime turned a darker color once it mixed with the moisture on the chicken cadaver and had an appearance similar to mud.

After I applied the chemicals to the assigned animal cadavers, I used the digital hanging scale to weigh each animal cadaver and observation cage to record the new initial weight after applying the chemical. This new weight would be used to calculate the weight of the animal cadaver to observe the process of decomposition. Table 9 shows the weight of the animal cadaver and observation cage before the chemical was applied, the weight after the chemical was applied, and the amount of the chemical applied. I used the same laminated tags containing the cadaver number and the assigned chemical from Experiment One and attached the labels to the observation cages with rubber bands.

Table 9

Weight of Animal Cadaver & Observation Cage Before and After Application of Chemical – Experiment Two

Cadaver	Assigned Chemical	Amount of Chemical	Weight Before (lbs.)	Weight After (lbs.)
1	Control	N/A	6.04	N/A
2	Bleach	121 fl. oz.	6.80	6.72
3	DEET	11 oz	6.91	6.97
4	Febreze®	67.6 fl. oz.	6.98	6.88
5	Avon®	0.5 cups	7.37	7.48
6	Pelletized Lawn Lime	3.0 cups	7.25	8.34

Note. The amount of chemical listed for Bleach, DEET, and Febreze® were the amounts provided on the container from the manufacturer. The amount of chemical listed for Avon® and Pelletized lawn lime are amounts that I measured to remain consistent with Experiment One.

After I prepared the animal cadavers, I proceeded to move all the new materials for Experiment Two to the roof of the Investigative Sciences Research and Teaching Laboratory. Between Experiment One and Experiment Two, I had received a new aluminum extension ladder. I used the aluminum extension ladder that I stored inside the Investigative Sciences Research and Teaching Laboratory to access the roof. I carried the ladder outside to the parking lot every day and then carried it back inside to store it when not in use. I used the aluminum extension ladder to

place the six aluminum full-size deep steam pans and the six observation cages containing the animal cadavers to the roof.

Once the materials were on the roof, I began to set up the experiment the same way I had in Experiment One. At the end of Experiment One, I knew I was going to reuse some of the materials for Experiment Two. Therefore, I left the 12 normal weight half concrete blocks, six Blue Hawk® welded silver steel chains, 12 Blue Hawk® zinc-plated quick links, and six blue plastic tarp rectangles on the roof of the Investigative Sciences Research and Teaching Laboratory. I left the concrete blocks in the same place so that when I set up Experiment Two, the chicken cadavers would be spaced out the same as the feline cadavers in Experiment One.

I untucked the blue plastic tarp from one side of the concrete blocks to place the observation cages on the concrete blocks. Each cadaver was placed on top of two normal weight half concrete blocks to remain consistent with Experiment One. I left the concrete blocks in the same location from Experiment One to remain consistent and in order to prevent interference between animal cadavers and chemicals. I placed an aluminum full-size deep steam pan on top of each pair of concrete blocks and placed an observation cage inside the aluminum full-size deep steam pan. The Blue Hawk® welded silver steel chains were still looped through the openings in the concrete blocks from Experiment One. I used the Blue Hawk® zinc-plated quick links to attach each end of the Blue Hawk® welded silver steel chain to opposite corners of the observation cage to anchor the cage to the concrete blocks, same as Experiment One.

Once the animal cadavers were in the right location and anchored to the concrete blocks, I photographed the animal cadavers to get initial photographs for the first day of the experiment. I then folded the tarp across the top of the observation cage and tucked the loose end of the tarp under the concrete blocks. I covered my observation cages for Experiment Two in order to remain consistent with Experiment One, even though my defeathered chicken cadavers did not have fur

like the feline cadavers. The tarps and new pans still allowed insects easy access to the observation cages from the sides. Figure 8 shows an observation cage anchored to the concrete blocks and covered by a tarp to demonstrate the setup of Experiment Two. Figure 9 shows the placement of the six animal cadaver observation cages across the roof of the Investigative Sciences Research and Teaching Laboratory at OSU-CHS for Experiment Two.

Figure 8

Animal Cadaver Observation Cage Set Up for Experiment Two

Note. These cages were built to hold and protect the animal cadaver from scavengers. The chains and concrete blocks were included to anchor the observation cages to prevent scavengers from moving the cages. The tarps were included to protect the cadavers from environmental factors to maintain reliable data. Setup for Experiment Two was the same as Experiment One.

Figure 9

Placement of Animal Cadaver Observation Cages for Experiment Two

Note. The cages were spaced out to prevent interference with each other in the same locations as Experiment One.

Once the experiment was completely set up, I used the ladder to climb down from the roof. I then carried the ladder back inside the Investigative Sciences Research and Teaching Laboratory where I stored the ladder when not in use. I followed the established a block of time between 1100 hours and 1300 hours from Experiment One to return and record daily observations for Experiment Two.

4.4.3 Experiment Observations. When I returned between 1100 hours and 1300 hours to check on my experiment and collect daily observations, I collected daily weights, photographs, and observations to provide data for the statistical analysis to remain consistent with Experiment One. Every day when I arrived at the Investigative Sciences Research and Teaching Laboratory, I carried my ladder outside and set it up in the parking lot to access the roof. The first thing I did when I accessed the roof was uncover all six of my animal cadavers by untucking one end of the blue tarp and unhook the Blue Hawk® zinc-plated quick links from the cadaver cage so that I could weigh the cadavers. I used the same composition notebook to record my observations. I

used the Weather Channel App to record the weather conditions in Tulsa, Oklahoma each day. I included the same daily weather conditions as Experiment One.

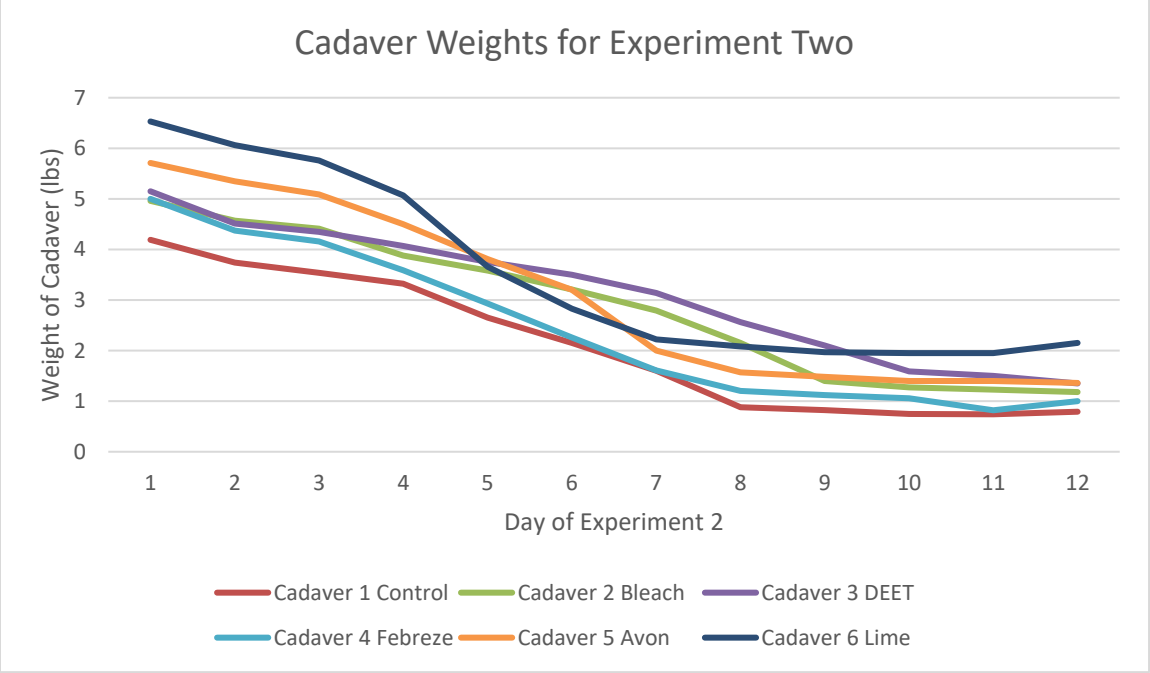
I followed the same procedure to document Experiment Two as I did for Experiment One. I recorded the time I began weighing the animal cadavers and observation cages with the digital hanging scale and recorded the weights in my composition notebook. I then anchored the observation cages again and began photographing the cadavers from a minimum of four angles. I photographed the animal cadaver from along both long sides (18in) of the observation cages and from the top to get a bird's eye view with the dry erase board the same way I did in Experiment One. I photographed the animal cadaver with the dry erase board and then zoomed in for a photograph of the animal cadaver closer up on the same side. The photograph had to be zoomed out in order to capture the dry erase board in the photograph. This led to four minimum photographs instead of three like Experiment One. Then, if there were noticeable changes to the animal cadaver, I took close up photographs to document the changes and wrote the observations down to remain consistent with Experiment One. Once I completed photographs on all six cadavers, I recovered the observation cages (see Figure 8). Once all cadavers and observation cages were anchored and covered, I descended from the roof and stored my ladder back inside the Investigative Sciences Research and Teaching Laboratory until I returned the following day.

4.4.4 Experiment Data. After reviewing previous studies, I performed Experiment One until the point that the weights of the animal cadavers began to plateau. I ended Experiment One after 30 days, therefore, I planned on performing Experiment Two for 30 days. However, Experiment Two seemed to progress faster than Experiment One. This could possibly be due to warmer temperatures or that the defeathered chicken cadavers were slightly smaller and had no fur. The first animal cadavers to start plateauing were Cadaver 1 – Control and Cadaver 6 – lime around day 7. The last animal cadaver to start plateauing was Cadaver 3 – DEET around day 10. On the night of May 30, 2018 (day 11 of Experiment Two), a thunderstorm came through Tulsa,

Oklahoma. The thunderstorm had strong winds that knocked some of my observation cages over, remains fell out of some of the cages, and some of the aluminum full-size deep steam pans filled with what appeared to be rain water. Going forward the damage and disruption to my experiment would have altered my data making it unreliable. The data for my chicken cadavers had already begun to plateau as seen in Experiment One, so the experiment was closed. Figure 10 provides a graph that illustrates the change in weight for all six animal cadavers compared to each other and to show the plateau of the animal cadaver weights.

Figure 10

Change in Animal Cadaver Weights for Experiment Two



I followed the same procedure as Experiment One by arriving between 1100 hours and 1300 hours and recording all of the same available daily weather conditions. Table 10 shows the weather conditions for Experiment Two.

Table 10

Experiment Two Weather Conditions

Day	Date	Time	Current Temp	High Temp	Low Temp	Humidity	Dew Point	Pressure	UV Index	Prec.	Wind	Conditions
1	5/20/18	1305	73°F	79°F	66°F	75%	65°F	30.04 in	4 moderate	30%	WSW 7 mpg	Cloudy
2	5/21/18	1235	80°F	84°F	64°F	53%	61°F	30.03 in	9 Very high	0%	E 1 mph	Partly Cloudy
3	5/22/18	1225	85°F	88°F	67°F	51%	65°F	29.99 in	9 Very high	10%	SSE 7 mph	Partly Cloudy
4	5/23/18	1223	82°F	84°F	67°F	62%	68°F	30.05 in	6 High	40%	SSE 6 mph	Mostly Cloudy
5	5/24/18	1245	83°F	88°F	68°F	62%	69°F	30.05 in	9 Very high	20%	S 8 mph	Fair
6	5/25/18	1223	78°F	87°F	68°F	60%	63°F	29.90 in	8 Very high	60%	NNE 9 mph	Partly Cloudy/ light rain
7	5/26/18	1245	90°F	95°F	68°F	37%	60°F	29.82 in	9 Very high	0%	SE 4 mph	Sunny
8	5/27/18	1207	89°F	93°F	68°F	49%	67°F	29.87 in	8 Very high	0%	SSE 7 mph	Partly Cloudy/ Fair
9	5/28/18	1218	88°F	93°F	70°F	47%	65°F	29.89 in	8 Very high	0%	SSE 8 mph	Sunny
10	5/29/18	1215	88°F	92°F	70°F	53%	69°F	29.77 in	8 Very high	0%	SSE 8 mph	Mostly Cloudy
11	5/30/18	1225	87°F	94°F	73°F	56%	69°F	29.72 in	9 Very high	20%	S 8 mph	Sunny
12	5/31/18	1213	86°F	92°F	74°F	63%	72°F	29.74 in	5 Moderate	0%	SSW 10 mph	Overcast

After recording the weather conditions, I followed the same procedure as Experiment One to weigh the defeathered chicken cadavers in Experiment Two. I weighed the empty observation cage before starting the experiment then recorded the daily weights for each cadaver.

I created tables for each animal cadaver recording the same information from Experiment One. This data was used to calculate decomposition rates for the chicken cadavers. These decomposition rates were added to the data for my statistical analysis. Table 11 shows the animal cadaver weight table for Cadaver 1 assigned to be the control. A similar table was made for each animal cadaver. See Appendix N for the animal cadaver weight tables for Cadavers 2 through 6.

Table 11

Animal Cadaver Weight Table – Cadaver 1 Control – Experiment Two

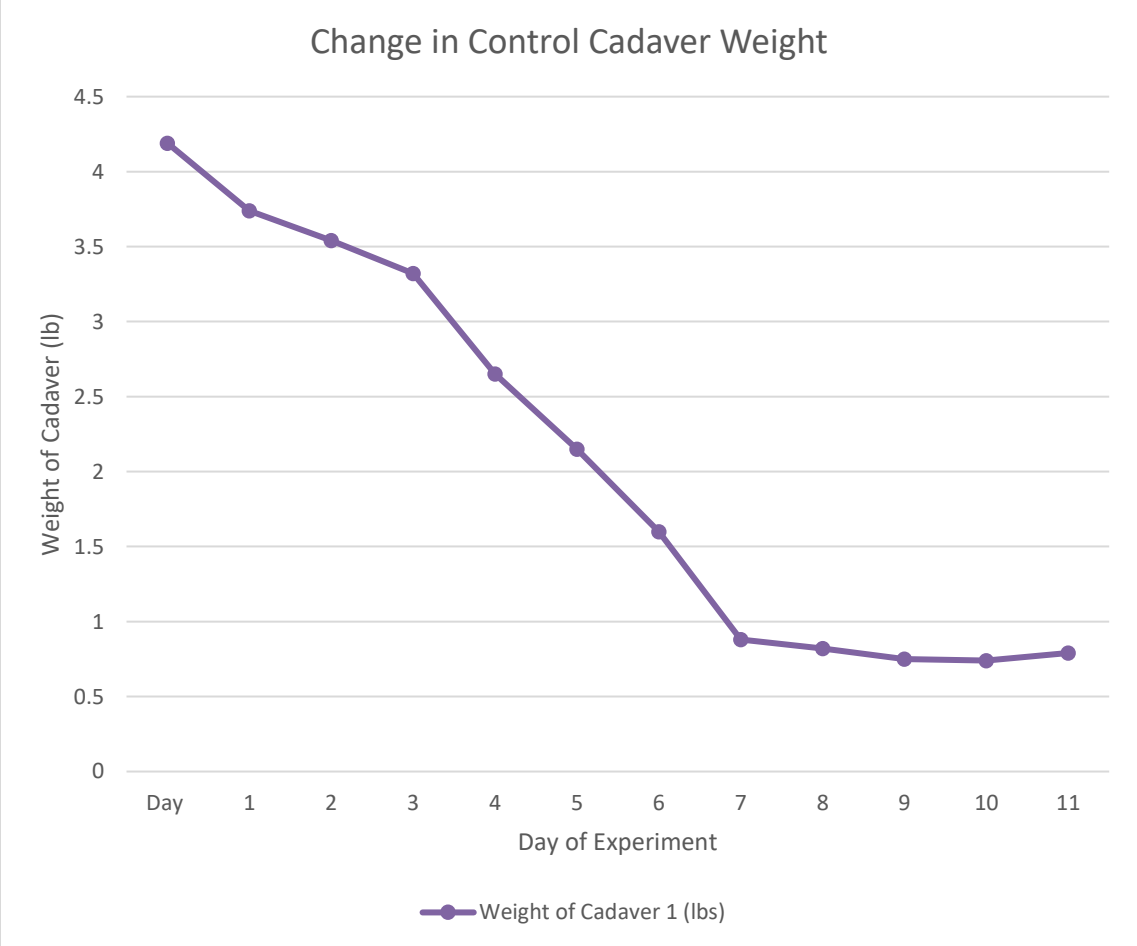
Day	Date	Time	Weight of Cage (lbs.)	Weight of Cadaver & Cage (lbs.)	Weight of Cadaver 1 (lbs.)	Change (lbs.)
1	5/20/18	1305	1.85	6.04	4.19	
2	5/21/18	1235	1.85	5.59	3.74	-0.45
3	5/22/18	1225	1.85	5.39	3.54	-0.20
4	5/23/18	1223	1.85	5.17	3.32	-0.22
5	5/24/18	1245	1.85	4.50	2.65	-0.67
6	5/25/18	1223	1.85	4.00	2.15	-0.50
7	5/26/18	1245	1.85	3.45	1.60	-0.55
8	5/27/18	1207	1.85	2.73	0.88	-0.72
9	5/28/18	1218	1.85	2.67	0.82	-0.06
10	5/29/18	1215	1.85	2.60	0.75	-0.07
11	5/30/18	1225	1.85	2.59	0.74	-0.01
12	5/31/18	1213	1.85	2.64	0.79	0.05

No consideration was made for any changes in weight of the observation cages. The pine board base was treated with polyurethane to protect the wood, but the pine base could have been altered or warped by external factors such as heat and humidity. Alterations to the pine board could cause changes in the weight of the cage and therefore alter the calculated weight of the animal cadavers. Also, no consideration was made for the weight of insects, including eggs and maggot swarms, on the animal cadavers' weights. The weight of any insects was considered part of the animal cadaver weight.

Throughout the process of the experiment, I graphed the animal cadaver weight for each cadaver to monitor the decline in weight and to determine when decomposition processes began to plateau. The length of the experiment was supposed to be the same as Experiment One, which was 30 days. However, the thunderstorm that hit overnight on May 30th (day 11) caused damage to Experiment Two that led to the early end of Experiment Two on May 31st (day 12). Figure 11 shows a graph of the change in weight for animal cadaver 1 assigned as the control. Each graph for the six different animal cadavers and chemicals were combined to compare the change in weight of all six cadavers in one graph as seen in Figure 10. See Appendix O for the change in animal cadaver weight graphs for Cadavers 2 through 6.

Figure 11

Change in Control Cadaver Weight – Experiment Two



Besides the weather conditions and the weight of the animal cadavers, I also photographed the animal cadavers daily to record the visual decomposition changes so that I could compare the changes after experiment completion. I photographed each animal cadaver a minimum of four times. The first photograph included the dry erase board with the cadaver number, chemical, date, and time I started photographing the cadavers. I took the first photograph along one of the long sides (18in) of the animal cadaver observation cage with the dry erase board. In order to capture the dry erase board in the photograph, I had to zoom out or back away from the cadaver. The second photograph would be along the same long side of the observation cage as the first photograph, but I would zoom in or move closer to the cadaver to get a better view of the cadaver. The third photograph included the bird's eye view of the animal cadaver taken from the top of the observation cage. The fourth photograph was taken from the opposite long side (18in) of the observation cage that was not featured in the first two photographs. I photographed the animal cadavers this way to include both visible sides and the top of the animal cadaver. In addition to these four photographs, I would photograph anything of interest or any changes that I noticed from the previous day. Items of interest included maggots, fluids, color change, bloating, other insects, or anything else that appeared throughout my experiment. Figure 12 shows the minimum four photographs that I obtained on each individual animal cadaver daily.

Figure 12

Minimum Four Photographs of Each Animal Cadaver Taken Daily – Experiment Two

Note. These four pictures represent the minimum four pictures taken of each cadaver daily. This is Cadaver 1 – Control on Day 1 of Experiment Two.

Photographing the animal cadavers at the same time daily for the duration of the experiment allowed me to compare the visible differences in decomposition rates between animal cadavers after being treated with different chemicals after experiment completion. Examining the animal cadavers daily made it difficult to notice every change that occurred to the animal cadavers. If you look at something constantly or every day, it can be difficult to notice every small change that occurs. Looking at the photographs after experiment completion provided

evidence of the changes that occurred from day to day. See Appendix Q for photographs of all six animal cadavers from Experiment Two. Over 200 photographs were obtained for Experiment Two. Additional photographs may be obtained upon request.

After I completed photographs, I recorded the same daily observations in my composition notebook as Experiment One. These observations provided useful information including when noticeable changes occurred and when insects arrived and the quantity. I recorded theses observations within a table for each animal cadaver. Table 12 shows the animal cadaver observations table for Cadaver 1 assigned as the control for Experiment Two. See Appendix P for the animal cadaver observations tables for Cadavers 2 through 6.

During the duration of Experiment 1 and Experiment 2, I was absent five collection days. During that time, I trained a fellow graduate student to collect data on these experiments under supervision and guidance from my research advisor.

Table 12

Animal Cadaver Observations Table – Cadaver 1 Control – Experiment Two

Day	Date	Odor	Color	Bloating	Fluids	Flies	Maggots	Beetles	Other insects	Other Observations/notes
1	5/20/18	none	none	none	blood/fluids	none	none	none	none	some blood and fluids from the package
2	5/21/18	none	yellow/ brown	none	blood/fluids	one	none	none	none	skin drying out and turning yellow/brown, red blood/fluids in the pan, fly approached as I was leaving
3	5/22/18	slight	golden brown	none	blood/fluids	few	none	none	none	about 3-5 flies, skin drying, skin bubbles
4	5/23/18	slight	golden brown	none	blood/fluids	several	tons	none	none	further drying of skin, skin bubbles, can see maggot eggs/small maggots, brown sludge coming from inside, maggots inside
5	5/24/18	strong	golden brown	deflating	brown sludge	some	tons	one	none	deflating or sinking around bones, brown sludge out rear end, looks greasy, one beetle bug on cage, maggots under cage
6	5/25/18	strong	golden brown	deflated	brown sludge	none	tons	none	none	golden brown with some pink, brown sludge at the rear end and in the pan, tons of maggots at the rear and in the pan
7	5/26/18	strong	golden brown	deflated	brown sludge	none	none	none	none	golden brown with some pink, brown sludge at the rear end and leaked into pan, no visible insects
8	5/27/18	strong	dark brown	deflated	brown sludge	none	none	one	none	brown and almost like sludge, looks like just skin and bone, 3 maggots under cage
9	5/28/18	strong	dark brown	deflated	brown sludge	none	none	none	none	Brown sludge and skin drying, looks like just skin and bone, some bones visible, appears greasy, laying flat
10	5/29/18	Strong	dark brown	deflated	fluid drying	none	none	none	none	looks like just skin and bone, sking and fluid drying, appears less greasy
11	5/30/18	strong	dark brown	deflated	fluid drying	none	none	none	none	just skin and bone, skin and fluid drying, appears less greasy
12	5/31/18	strong	dark brown	deflated	rain water	none	none	none	none	just skin and bone, pan filled with rain water, appears less greasy

4.5 Quantitative Methodology

Analysis of variance (ANOVA) was used to determine if any relationships existed between decomposition rates of the animal cadavers and the different chemicals applied

4.5.1 Statistical Analysis. Tables 6 and 11 show the animal cadaver weight table for Cadaver 1 assigned to be the control. Appendices J and N show the animal cadaver weight tables for Cadavers 2 through 6. I used the weights recorded in the animal cadaver weight tables to calculate decomposition rates to determine if any significant differences existed between decomposition rates due to the application of different chemicals.

For the statistical analysis, only the data that matched the days from the second experiment were analyzed. Therefore, only the data from day 1 to day 12 for both experiments were used in the statistical analysis since Experiment Two was damaged by a rain storm resulting in the experiment ending on day 12. The later days, day 13 through day 30, of Experiment One were removed for the statistical analyses.

4.5.2 Results of Statistical Analysis. The change in weight from the beginning of the experiment to the end of the experiment was calculated. The mean weight (MNWTDELTA) and standard error (SEWTDELTA) for Delta were calculated for all six chemicals. Table 13 shows the one-way ANOVA for the difference in weights, from start to finish, with the dependent variable of WTDELTA.

Table 13

One-Way ANOVA of Difference in Weights

TRT	MNWTDELTA	SEWTDELTA	PVALUE
Avon®	2.305	2.045	0.2028
Bleach	2.570	1.210	
Control	1.750	1.650	
DEET	2.245	1.555	
Febreze®	2.645	1.355	
Lime	3.225	1.155	

Note. Dependent variable is WTDELTA.

In the one-way ANOVA of difference in the weights, from start to finish, the reported p-value is p=0.2028. Since the p-value is above the 0.05 level, there is no statistically significant differences indicated in the differences in animal cadaver weights, from start to finish of the experiment. The next statistical analysis performed was a one-way ANOVA of the calculated weight ratios by dividing the final weight by the starting weight. This statistical analysis calculated the weight ratios (WTRATIO) for each chemical by dividing the end weight by the beginning weight of the animal cadavers for each chemical treatment. The mean (MNWTRATIO) and standard error (SEWTRATIO) were then calculated for each weight ratio. Table 14 shows the results of the one-way ANOVA of the calculated weight ratios with a dependent variable of WTRATIO.

Table 14

One-Way ANOVA with Weight Ratios (Final wt/Starting wt)

TRT	MNWTRATIO	SEWTRATIO	PVALUE
Avon®	0.59456	0.35638	0.8555
Bleach	0.48456	0.24666	
Control	0.58361	0.39507	
DEET	0.58579	0.32366	
Febreze®	0.52728	0.32728	
Lime	0.52206	0.19281	

Note. Dependent variable is WTRATIO

In the one-way ANOVA of the weight ratios, the reported p-value is p=0.8555. Since the p-value is above the 0.05 level, there are no statistically significant differences indicated by the weight ratios in the differences in animal cadaver weights due to chemical treatments. Additional statistical analyses were performed on the raw weights to investigate the effects of treatments and time (see Table 15). Overall, there is no effect of chemical treatment on the animal cadaver weights. However, time has such a great effect that it practically masks any small effects that the chemical treatments might have. Therefore, chemical treatment does so little that its effect cannot be seen when time is also involved.

Table 15

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
TRT	5	5.26	0.65	0.6746
Day	11	65.7	5.23	<.0001
Day*TRT	55	64	0.24	1.0000

Note. Dependent variable is weight.

If looking at the overall effects of the chemical treatments, the reported p-value is p=0.6746. Since the p-value is greater than 0.05, there is no statistically significant differences in decomposition rates due to the chemical applied. If looking at the effect of time, the reported p-value is p=<0.0001 indicating a statistically significant difference in decomposition rates due to the time allowed. It is also possible to look at the simple effects by looking at the effects of the chemical treatments given time. This analysis looks at the effects of each chemical for the first 12 days of the experiment. Table 16 provides the means, standard errors, and the p-values for the data for the first 12 days of the experiments.

Table 16

Effect of Treatment Given Time

Day	TRT	MNWT	SEWT	PVALUE
1	Avon®	5.505	0.205	0.5637
1	Bleach	5.010	0.050	
1	Control	4.440	0.250	
1	DEET	6.385	1.235	
1	Febreze®	6.935	1.935	
1	Lime	6.895	0.365	
2	Avon®	5.265	0.085	0.6365
2	Bleach	4.725	0.155	
2	Control	4.265	0.525	
2	DEET	6.035	1.525	
2	Febreze®	6.550	2.180	
2	Lime	6.490	0.430	
3	Avon®	5.115	0.025	0.6410
3	Bleach	4.635	0.225	
3	Control	4.140	0.600	
3	DEET	5.915	1.565	
3	Febreze®	6.455	2.295	
3	Lime	6.325	0.565	
4	Avon®	4.805	0.305	0.7044
4	Bleach	4.405	0.525	
4	Control	4.085	0.765	
4	DEET	5.810	1.740	
4	Febreze®	6.120	2.530	
4	Lime	5.955	0.885	
5	Avon®	4.150	0.340	0.7806
5	Bleach	4.140	0.560	

5	Control	3.675	1.025	
5	DEET	5.520	1.770	
5	Febreze®	5.520	2.590	
5	Lime	4.955	1.295	
6	Avon®	4.155	0.955	0.7457
6	Bleach	4.060	0.850	
6	Control	3.445	1.295	
6	DEET	5.510	2.010	
6	Febreze®	5.445	3.185	
6	Lime	4.815	1.985	
7	Avon®	3.520	1.520	0.7112
7	Bleach	3.870	1.080	
7	Control	3.195	1.595	
7	DEET	5.305	2.165	
7	Febreze®	5.145	3.535	
7	Lime	4.465	2.245	
8	Avon®	3.345	1.775	0.6776
8	Bleach	3.445	1.295	
8	Control	2.830	1.950	
8	DEET	5.015	2.455	
8	Febreze®	4.905	3.705	
8	Lime	4.375	2.295	
9	Avon®	3.290	1.810	0.6758
9	Bleach	3.000	1.600	
9	Control	2.800	1.980	
9	DEET	4.745	2.645	
9	Febreze®	4.850	3.730	
9	Lime	4.270	2.300	
10	Avon®	3.215	1.815	0.7200
10	Bleach	2.890	1.620	

10	Control	2.745	1.995	
10	DEET	4.440	2.850	
10	Febreze®	4.740	3.680	
10	Lime	4.180	2.230	
11	Avon®	3.220	1.820	0.7739
11	Bleach	2.715	1.485	
11	Control	2.705	1.965	
11	DEET	4.285	2.785	
11	Febreze®	4.450	3.630	
11	Lime	4.065	2.115	
12	Avon®	3.200	1.840	0.8000
12	Bleach	2.440	1.260	
12	Control	2.690	1.900	
12	DEET	4.140	2.790	
12	Febreze®	4.290	3.290	
12	Lime	3.670	1.520	

After analyzing the simple effects of the chemical treatments given time, the p-values for the first 12 days of the experiment were all above the 0.05 level. This indicates that there are no statistically significant differences in decomposition rates due to the simple effects of the chemical treatments given time.

4.5.3 Discussion of Statistical Results. Overall, the results of the statistical analyses showed that there are no significant differences between the change in weight of the animal cadavers after being treated with different chemicals and the control cadaver. Analyzing the differences in cadaver weights and cadaver weight ratios showed no statistically significant differences in chemical used with or without time in the equation. The only variable that caused any statistically significant differences was time, which is to be expected. More time allowed for

decomposition processes results in further stages of decomposition and different decomposition rates. However, the chemical treatments effect the cadavers so little that it's effects can't be seen when time is involved because time has such a great effect that it basically masks any small effects of the chemicals.

Even though the statistical analyses did not show any statistically significant differences in decomposition rates due to the application of chemicals, I did notice some significant visual observations that might indicate differences in decomposition. During Experiment One, it seemed like Cadaver 2 Bleach and Cadaver 6 Lime moved through the decomposition processes faster than the other four animal cadavers. The weight for Cadaver 6 Lime was the first animal cadaver to start plateauing around day 15 and Cadaver 2 Bleach started plateauing around day 16. Both cadavers began bloating around day 9 or 10 and only remained bloated for 3 or 4 days before deflating. Maggots were also visible on both cadavers starting on day 9 before any other cadavers had visible maggots. Cadaver 2 Bleach and Cadaver 6 Lime seemed to deflate and had what appeared to be holes where maggots had eaten through the skin. It did appear that the maggots worked from the inside out to avoid the fur of the feline cadavers. Cadaver 6 Lime even had bones visible near the rear end of the cadaver by day 13 of Experiment One. Using visual observations to observe decomposition rates indicated that lime and bleach initially sped up decomposition processes or did not affect the insects in a way to slow down decomposition processes. Another interesting observation for Experiment One is that I saw no insects until day 6. This could possibly be due to the weather and rainy conditions at the beginning of my experiment, or the chemicals that were applied helped deter insects from approaching the cadavers.

Also, in Experiment One, visual observations indicated that DEET insect repellent slowed down decomposition processes resulting in the DEET cadaver decomposing the slowest. Cadaver 3 DEET bloated, produced fluids, and attracted insects on day 7 of Experiment One.

Maggots were not easily visible until day 10 and then were not seen again until day 16. Maggots were sometimes difficult to observe since most of them were inside the animal cadavers working from the inside out. It was also difficult to see through the fur to find maggots. Cadaver 3 DEET did not begin deflating until day 15 of Experiment one, meaning that it remained bloated for 8 days. The weight for Cadaver 3 DEET did not begin to plateau until around day 23 of Experiment One. I suspect that the slow decomposition processes for Cadaver 3 DEET are due to the DEET insect repellent deterring insects from approaching the cadaver. Another cadaver that appeared to decompose slower was Cadaver 4 Febreze®. The weight for Cadaver 4 Febreze® didn't begin to plateau until around day 21, which was slightly before Cadaver 3 DEET. Cadaver 4 Febreze® bloated, produced fluids, and attracted insects between days 5 and 7 of Experiment One. Maggots were not easily visible until day 11. Cadaver 4 Febreze® did not begin deflating until day 19 of Experiment One, meaning that it remained bloated for 13 days before noticeably deflating. I suspect that the slow decomposition processes for Cadaver 4 Febreze® was due to the Febreze® masking decompositional odors and deterring insects from detecting and approaching the cadaver. However, the varying sizes of animal cadavers needs to be taken into consideration for the slow decomposition processes of Cadaver 3 DEET and Cadaver 4 Febreze® since these two cadavers appeared larger than some of the other cadavers. Size can play a slight role in the decomposition rates and processes. A smaller cadaver can decompose faster than a large cadaver due to less tissue being available to decompose.

During Experiment Two, it seemed like Cadaver 1 Control and Cadaver 6 Lime moved through the decomposition processes slightly faster than the other four animal cadavers. The weights for Cadaver 1 Control and Cadaver 6 Lime were the first animal cadavers to start plateauing around day 7 of Experiment Two. The defeathered chickens did not have any organs and were hollow. It was difficult to observe any noticeable bloating to the chicken cadavers if it occurred. However, I was able to observe the deflating of the chicken cadavers. Both cadavers

began deflating on day 5 of the experiment. I was able to observe moisture and fluids on day 1 for Cadaver 6 Lime due to the application of lime. All of the defeathered chickens had moisture from the packaging, but the moisture and fluids mixed with the Lime resulting in the appearance of mud on the cadaver. I observed flies on day 2 and maggots on day 4 on Cadaver 6 Lime. Blood and fluids were noticeable for Cadaver 1 Control on day 2, followed by flies on day 3 and maggots on day 4.

Since the defeathered chicken cadavers were hollow, most of the maggot swarms were located inside of the chicken cadaver. The maggots seemed to work from the inside out for Experiment Two, the same way they did in Experiment One. However, this could be due to the fact that the chicken cadavers were already hollow and allowed easy access to the inside of the cadaver. The insects seemed to eat the flesh of the chicken cadaver from the inside but left the skin intact. Using visual observations to monitor decomposition processes indicated that lime followed similar decomposition processes and rates as the control cadaver or the lime did not affect the insects in a way to slow down decomposition processes. The weather conditions need to be considered when looking at Experiment Two. The temperatures were much warmer in Experiment Two than in Experiment One as we moved closer into summer. I suspect that the warmer temperatures in Experiment Two led to the faster decomposition processes of the chicken cadavers.

Also, in Experiment Two, visual observations indicated that DEET insect repellent slowed down decomposition processes resulting in the DEET cadaver decomposing the slowest. Fluids and blood became visible on Cadaver 3 DEET on day 2 of the experiment. Cadaver 3 DEET appeared to slightly bloat on day 5 and began deflating on day 7. Maggots became easily visible on day 5 after the appearance of flies on day 4. The weight for Cadaver 3 DEET did not begin to plateau until around day 10 of Experiment Two. I suspect that the slow decomposition processes for Cadaver 3 DEET are due to the DEET insect repellent deterring insects from

approaching the cadaver, supported by the datum that flies were not documented until day 4 which was after flies were noted on the other 5 cadavers.

Another cadaver that appeared to decompose slower was Cadaver 2 Bleach. This greatly differs from the data in Experiment One where the bleach cadaver was observed to decompose the second fastest after lime. The weight for Cadaver 2 Bleach didn't begin to plateau until around day 9, which was slightly before Cadaver 3 DEET. Blood and fluids were noticeable on day 2 of the experiment, flies arrived on day 3, and maggots were noticeable on day 4. Cadaver 2 Bleach seemed to slightly bloat on day 5 and began to deflate on day 6. The bleach cadaver for Experiment Two was slowly behind the DEET cadaver instead of second fastest in Experiment One. I suspect that the bleach cadaver in Experiment Two reacted differently due to not having any fur or feathers to soak up and retain the bleach that was applied. In Experiment One, the feline cadaver had fur that retained some of the bleach and the enzymes in the bleach may have helped decompose or break down the feline cadaver. However, in Experiment Two most of the bleach just rolled off the skin of the chicken cadaver. Therefore, the bleach enzymes were not retained to possibly help with the decomposition and breaking down of the chicken cadaver.

All of the chicken cadavers in Experiment Two were similar in weight, so size didn't make a huge difference in decomposition rates and processes. However, all of the chicken cadavers were defeathered and therefore, were unable to retain or soak up any of the liquid chemicals that were applied like in Experiment One. One benefit of using the defeathered chicken cadavers is that the chicken cadavers are similar to humans. Humans do not have fur or feathers to retain any chemicals, we have skin just like the defeathered chicken cadaver did. The only time chemicals would be retained on a human would be if clothing remained on and absorbed any chemicals.

Experiment One and Experiment Two show similar results. Application of lime seemed to speed up decomposition processes initially before plateauing to regular decomposition rates, which has been shown in previous studies. The weight for the lime cadavers were the first to plateau in both experiments. In Experiment One, decomposition processes of the lime cadaver were followed by the decomposition processes of the bleach cadaver and then the control cadaver. In Experiment Two, the plateau for the lime cadaver occurred at the same time as the control cadaver and was then followed by the Febreze® and Avon® cadavers.

In both experiments, the application of a DEET insect repellent seemed to result in that cadaver decomposing the slowest. It was the last animal cadaver to have the weights plateau in both experiments suggesting that DEET did have some effect on the insects or decomposition processes that resulted in reduced decomposition rates compared to the other chemicals tested in these experiments. In Experiment One, the second slowest decomposition rate was for the Febreze® cadaver. However, Febreze® was the third slowest cadaver to decompose for Experiment Two and the second slowest cadaver to decompose was Cadaver 2 Bleach. Overall, visual observations from both experiments suggest that lime helped speed up the process of decomposition initially or didn't affect the insects to delay decomposition and that DEET insect repellent slowed the process of decomposition and deterred insects from approaching the cadaver carcasses resulting in delayed insect arrival. In conclusion, despite the efforts I attempted to alter or mask decomposition by applying different chemicals, none of them appeared to significantly impact decomposition rates.

CHAPTER V

CONCLUSION

5.1 Summary of Research

This research used a mixed methodology to gather data on attempts taken by criminal offenders to alter and mask decomposition and the effectiveness of such attempts. First, I collected questionnaire responses to identify previous chemicals observed in past criminal cases in Oklahoma. I then chose five chemicals based off my questionnaire responses and literature review to test in my experiment. Second, I performed an experiment to test the effects of the chemicals identified by my questionnaire and literature review on animal cadavers to measure decomposition rates. Last, I performed an Analysis of Variance (ANOVA) on the decomposition rates to determine any significant differences in decomposition rates after the application of different chemicals.

I created and sent a questionnaire to forensic pathologists, forensic anthropologists, forensic archaeologists, and death scene investigators employed by the Office of the Chief Medical Examiner in Oklahoma. The questionnaire identified chemicals previously observed in criminal cases in Oklahoma to alter or mask decomposition. The questionnaire responses were not concentrated with multiple observations; therefore, I chose five chemicals based on the questionnaire responses and literature review. I chose lye/lime, bleach, and Febreze® from my questionnaire responses and chose N,N-diethyl-meta-toluamide (DEET) and Avon® Skin So Soft

body lotion based on my literature review. I chose DEET because it has gained interest in recent studies. I included Avon® Skin So Soft lotion to include a natural remedy since some believe that Avon® body lotion acts as an insect repellent and there is a gap in current literature on the effects of natural remedies on decomposition rates and processes.

After reviewing previous studies, I performed the experiment to the point that the cadaver weights began to plateau. Experiment One tested the five chosen chemicals on feline cadavers for 30 days. I prepared observation cages to protect my animal cadavers and anchored them to concrete blocks. I covered my cadavers in the assigned chemicals and placed them outside to decompose on the roof of the Investigative Sciences Research and Teaching Laboratory at Oklahoma State University Center for Health Sciences (OSU-CHS). I collected daily weights, photographs, and observations to provide data for the statistical analysis. Once the first experiment was completed, I replicated the experiment and compared the data sets.

After Experiment One, I experienced a delay with receiving my second round of feline cadavers. My literature review provided evidence that fur on animals can alter decomposition processes. I experienced this in Experiment One with the feline cadavers. After speaking with my committee, we chose to use defeathered chickens as the animal cadavers in Experiment Two. Experiment Two tested the same five chosen chemicals on defeathered chicken cadavers for 12 days. I reused the observation cages to protect my animal cadavers and anchored them to the same concrete blocks, the same way I performed Experiment One. I covered my cadavers in the same assigned chemicals and placed them outside to decompose on the roof of the Investigative Sciences Research and teaching Laboratory at OSU-CHS in the same arrangement as Experiment One. I collected daily weights, photographs, and observations to provide data for the statistical analysis. On the night of day 11 (May 30th), a storm damaged my experiment that would cause unreliable data moving forward; therefore, my committee and I chose to end Experiment Two after 12 days.

After Experiment One and Experiment Two were completed, I compared the data sets. I created tables for the change in animal cadaver daily weights for each animal cadaver. I calculated the decomposition rate for each animal cadaver to use in the statistical analysis. Only the data from the first 12 days of both experiments were including in my statistical analysis due to the damage incurred by Experiment Two. A Type 3 Test of Fixed Effects was performed for my experiments with an overall p-value of $p=0.6746$ for the chemical treatments. This p-value was above the $p<0.05$ level which indicates no statistically significant differences. Time, however, did have a statistically significant difference on decomposition weights with a p-value of $p=<0.001$. The simple effects of the chemical treatments were then analyzed for the first 12 days of the experiments. The p-value for each day was above the $p<0.05$ level indicating no statistically significant difference. An analysis of variance (ANOVA) was performed for the difference in weights, from start to finish, excluding the variable of time. This ANOVA produced a p-value of $p=0.2028$, indicating no statistically significant differences either. Last, an ANOVA was performed for the calculated weight ratios and produced a p-value of $p=0.8555$. This p-value also indicates no statistically significant differences.

Overall, the results of the statistical analyses showed that there are no statistically significant differences between the change in weight of the animal cadavers after being treated with different chemicals. Analyzing the fixed and simple effects of the chemical treatments, differences in cadaver weights, and cadaver weight ratios, showed no statistically significant differences with or without time in the equation. The only variable that caused any statistically significant differences in decomposition rates was time. The chemical treatments effect the cadavers so little that it's effects can't be seen when time is involved because time has such great effects that it basically masks any small effects of the chemicals.

Even though the statistical analyses failed to show significant differences in decomposition rates due to the application of chemicals, I did observe visual observations that

suggest differences in decomposition rates and processes. Experiment One and Experiment Two both showed that the application of lime seemed to speed up decomposition processes initially before plateauing, which is supported in previous studies. Both experiments also demonstrated that DEET insect repellent seemed to result in slower decomposition processes.

There also seemed to be differences between fur-bearing and non-fur-bearing animal cadavers. In Experiment One, the feline cadavers had fur that absorbed or retained the liquid chemicals that were applied which may have helped deter insects from approaching the cadavers. Once insects were visible, it appeared that the maggots worked from the inside out to avoid the fur of the feline cadavers. In Experiment Two, the defeathered chicken cadavers did not have fur. Therefore, chemicals were not retained as well as the feline cadavers. The chicken cadavers were also hollow with the organs removed, providing easy access to insects. The insects arrived much sooner to the chicken cadavers than the feline cadavers, possibly due to the fur retaining the chemicals, and the insects also worked from the inside out. However, this is possibly due to the fact that the chicken cadavers were already hollow.

One chemical that supports the differences between fur-bearing and non-fur-bearing animal cadavers is bleach. In Experiment One the feline cadaver treated with bleach decomposed the second fastest and in Experiment Two the chicken cadaver treated with bleach decomposed the second slowest. The feline cadaver had fur to soak up and retain the bleach, unlike the chicken cadaver where the bleach just ran off the skin. Since the feline cadaver soaked up the bleach, the enzymes found in the bleach were retained and possibly helped with the break down and decomposition of the cadaver. The bleach enzymes were not retained on the chicken cadaver resulting in a difference between Experiment One and Experiment Two between fur-bearing and non-fur-bearing cadavers. In conclusion, despite the efforts I attempted to alter or mask decomposition by applying different chemicals, none of them appeared to significantly impact decomposition rates.

5.2 Areas for Future Research

This research could be expanded in multiple areas. This study was conducted in Tulsa, Oklahoma, which is an urban city. It would be beneficial to expand this study to include multiple areas, not just one location. Decomposition is altered by a variety of factors including climate, weather conditions, insects, scavengers, and time of year. All of these factors would need to be included in future research to truly understand how different chemicals may alter or mask decomposition. It would be beneficial to test the same chemicals within a variety of areas to determine the true effects of the chemical on decomposition processes.

Due to time constraints, this research could not be tested for a longer period of time or more than twice. This experiment was only replicated once for a total of two experiments. The first experiment lasted 30 days and the second only 12 days. Other studies may have the time and resources to conduct a longer experiment in order to better observe the effects of chemicals on decomposition rates. Other studies may also have the time and resources to test different animal cadavers than the ones used in this study. I used feline and defeathered chicken cadavers due to the availability, size, and time constraints. The most common animal cadaver used to relate studies to humans is pigs due to similar structure shared between pigs and humans. Other studies may be able to test chemicals on pig cadavers in order to better relate the study results to humans.

In addition, this research could only test a small number of chemicals due to funding and time constraints. Other studies may be able to test a larger number of chemicals to determine if any chosen chemicals effect decomposition rates and processes. There are a wide variety of chemicals available to the public and how every chemical will alter or mask decomposition is unknown. Other studies may be able to fill a gap within previously published literature about how available chemicals alter and/or mask decomposition to assist criminal investigations. Other studies may also be able to add more natural remedies to the chemicals tested to help fill the gap

within previous literature about how natural remedies may affect decomposition processes. Oral responses to my questionnaire suggested certain Native American tribes that use coffee grounds, copper, and other natural remedies with burials. Future studies could include these other traditions to help understand how these materials may change decomposition processes.

Lastly, future research could increase the sample size for the questionnaire. This questionnaire was only sent to a population within Oklahoma. Different states or areas may have different results based on their location and culture. Having a wider range of participants for the questionnaire could help concentrate questionnaire responses of specific chemicals to determine which chemicals are more popular in criminal cases. Other studies may have the time and resources to question a larger population about chemicals previously observed in criminal cases to test in an experiment. Testing more popular chemicals will provide better assistance to criminal investigations.

5.3 Limitations

This research is limited by the small sample size for the questionnaire. The small sample size led to a low number of responses to the questionnaire, and of those that responded, several participants had not observed chemicals in previous criminal cases. Participants with no experience of chemicals to alter or mask decomposition in past criminal cases led to a small number of chemicals reported to choose from to test in the experiment. Adherence to confidentiality also limited the research. Some questionnaire responses were vague and further discussion would have been beneficial. In order to keep confidentiality, I was unable to confront or question participants about the questionnaire or responses. Upon arrival of questionnaire responses, I did know the participant that submitted the response due to my employment and email delivery system. However, to help maintain confidentiality I saved responses with no identifying information and double-deleted the emailed responses.

Performing an experiment in this study presented another limitation. Several variables within experiments are controlled and may not represent realistic results for a real-life situation. There are also variables within an experiment that cannot be controlled, such as the weather in my research. Experimental research designs can help with reliability, but not all experiments may be generalizable to a larger population. For the setup of this experiment, I chose to cover my animal cadavers with tarps to protect the cadavers from environmental factors, including the rain. Protecting my cadavers from the rain ensured internal validity and reliability for my experimental data; however, covering my animal cadavers in my experiment does not exactly match real life situations for decomposing remains left outdoors. My animal cadavers were also secured in cages and anchored down to prevent scavengers from removing remains; however, these precautions do not meet real life situations. Experimental research is beneficial, but it can be difficult to generalize the results to real life situations.

Another limitation presented with my experiment is the variances in weighing techniques and the change in weight of the observation cages. I weighed the observation cages for Experiment One three times in a row with the digital hanging scale to better validate my instrument and look for any errors in weighing techniques. The digital hanging scale was not anchored and had to be held in order to weigh the animal cadavers and observation cages. However, any movement or changes to weighing techniques could alter the final weight. The weights of the cages fluctuated depending on how the scale was held during weighing. The wind also altered the weight portrayed on the scale due to causing the observation cage to move while being weighed. Variances in weighing techniques could alter the weight portrayed on the scale, thus creating an error rate in the experimental data.

The experiment is also limited by the use of animal cadavers. Experiment One used feline cadavers due to size and availability. Experiment Two used defeathered chicken cadavers due to the delay in feline cadavers and the literature review. The most common animal cadaver used as a

model for human decomposition is pig carcasses because they share several physical characteristics with humans. Using cadavers with similar physical characteristics as humans, allows for the results of the experiment to be generalized to humans. The use of feline and defeathered chickens also limited this study due to fact that the chemicals used to euthanize and process the cadavers were not considered in the experiment.

Additionally, the weather conditions for the experiment cannot be controlled leading to limitations. During Experiment Two, we experienced a storm over night that damaged the setup of my experiment. The storm had rain and high winds that knocked some animal cadavers and observation cages over, as well as filled some of the full-size deep steam pans with what appeared to be rain water. This storm led to the early ending of Experiment Two. Not being able to complete Experiment Two limited the available data for comparison and analysis with Experiment One. The data for Experiment Two was following the same pattern as Experiment One but did not get to fully plateau the same over the full 30 days. The damage to Experiment Two then limited the data that could be used in the statistical analyses. Only days 1 through 12 were used in the statistical analysis, therefore days 13 through 30 from Experiment One were removed. This causes limitations since the animal cadaver weights did not begin to plateau in Experiment One until day 15 and that data was removed.

5.4 Research Implications

This research effectively demonstrated that certain chemicals can alter or mask decomposition based on visual observations. However, despite the efforts made to alter or mask decomposition processes with chemicals, none of them appeared to statistically impact decomposition rates at the $p<0.05$ level. The implications of these findings suggest that decomposition rates and processes can be altered with chemicals and we lack a good understanding of how chemicals effect decomposition. Most studies focus on a single chemical

and do not compare the effects of multiple chemicals. There is a wide variety of easily accessible chemicals to the public, and how all of these chemicals effect decomposition is unknown. Understanding how a variety of chemicals effect decomposition rates and processes can aid criminal investigators with future death scene investigations and more accurate time frames to determine time of death estimations in order to assist in criminal cases.

Crime is never going to go away, and criminals are never going to stop trying to find new methods of hiding crimes. It is increasingly important that we identify and study methods of altering and/or masking decomposition to better understand the attempts criminals may take when committing a crime. By identifying and studying a variety of methods to alter and/or mask decomposition, there is a greater likelihood of identifying such attempts in future criminal cases and therefore, identifying the criminal responsible.

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APPENDIX A

IRB Approval

Oklahoma State University Institutional Review Board

Date:	Thursday, August 24, 2017
IRB Application No	CH175
Proposal Title:	A Comparison Study of Attempts Taken by Criminal Offenders to Alter and Mask Decomposition
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 8/23/2020

Principal Investigator(s):

Meagan Thumann — Ronald R. Thrasher

Stillwater, OK 74078 — , OK

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☐ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Scott Hall (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Hugh Crethar, Chair
Institutional Review Board

APPENDIX B

IACUC Request Letter

SCHOOL OF
Forensic Sciences

CENTER FOR HEALTH SCIENCES

1111 West 17th Street
Tulsa, Oklahoma 74107-1898
918-561-1145
Fax 918-561-5729

August 2, 2017

Ron Van Den Bussche, Ph.D., Chair
Animal Use Committee
Oklahoma State University
Stillwater, Oklahoma 74076

RE: Graduate Student Research

Dr. Van Den Bussche:

Please accept this letter as a request for Animal Use Committee review of planned research at the OSU School of Forensic Sciences. This graduate student research focuses on attempts by criminal offenders to alter or mask victim decomposition. The student plans to place deceased animals in wire containers treated with various commercial chemicals with the intent to alter decomposition or mask decomposition odors. Rates of decomposition will be measured and compared.

No animals will be harmed or killed for the purpose of this research. Animals will be obtained from the City of Tulsa Animal Control and were euthanized by the City of Tulsa as an animal control function, not for the purpose of this research. Protocol for the handling of deceased animals will be the same protocol used by the Oklahoma Office of the Chief Medical Examiner for the handling of human cadavers.

Thank you very much for this consideration and review. Please contact me if I can provide any additional information or assistance.

Sincerely,

Ronald R. Thrasher, Ph.D.
Associate Professor, Oklahoma State University
School of Forensic Sciences-Center for Health Sciences

APPENDIX C

IACUC Exemption

Ron:

Hello. I apologize for the delayed response. I met with our IACUC Manager, my Vice Chair and our two attending vets about this request/research. We are all in agreement that this does NOT require IACUC approval. With regards to obtaining a letter from the IACUC stating that, it was brought to my attention that CHS has their own IACUC. Thus, you should be seeking a letter from your IACUC as we do not hold any regulatory authority at CHS.

Please let me know if I can be of further assistance and I will let you know some time when I am in Tulsa and have time for a tour of your facility. Both Kenneth Sewell (VPR) and I would like to visit – just finding time on the schedule.

Ron

Ronald A. Van Den Bussche
Associate Vice President for Research
Regents Professor of Integrative Biology
IACUC Chair
203 Whitehurst
Oklahoma State University
Stillwater, OK 74078
405-744-6501
ron.van_den_bussche@okstate.edu

APPENDIX D

Participant Information Sheet

PARTICIPANT INFORMATION
OKLAHOMA STATE UNIVERSITY

Title: A Comparative Study of Attempts Taken by Criminal Offenders to Alter and Mask Decomposition

Investigator(s): Meagan Thumann, B.S.; Ronald R. Thrasher, Ph.D.

Purpose: The purpose of the research study is to identify attempts used by criminal offenders to alter or mask decomposition and determine their effectiveness.

What to Expect: This study is administered through an email. Participation in this research will involve completion of one questionnaire. The questionnaire will ask for any attempts you have seen in the past by criminal offenders to alter or mask decomposition. You may skip any questions that you do not wish to answer. There is one questionnaire that should take about 30 minutes to complete.

Risks: There are no risks associated with this project which are expected to be greater than those ordinarily encountered in daily life.

Benefits: There are no direct benefits to you. However, you may gain an appreciation and understanding of how research is conducted.

Your Rights and Confidentiality: Your participation in this research is voluntary. There is no penalty for refusal to participate, and you are free to withdraw your consent and participation in this project at any time.

Confidentiality: The records of this study will be kept private. Any written results will discuss group findings and will not include information that will identify you. Research records will be stored on a password protected computer in a locked office and only researchers and individuals responsible for research oversight will have access to the records.

Contacts: You may contact any of the researchers at the following addresses and phone numbers, should you desire to discuss your participation in the study and/or request information about the results of the study: Meagan Thumann, B.S., School of Forensic Sciences at Oklahoma State University, Tulsa, OK 74107, meagan.thumann@okstate.edu, 936-556-3187 or Ronald R. Thrasher, Ph.D., School of Forensic Sciences as Oklahoma State University, Tulsa, OK 74107, r.thrasher@okstate.edu, 918-561-1415. If you have questions about your rights as a research volunteer, you may contact the IRB Office at 223 Scott Hall, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu

If you choose to participate: Returning your completed survey via email indicates your willingness to participate in this research study.

APPENDIX E

Forensic Sciences Questionnaire

1) What kind of efforts have you encountered involving people trying to alter and/or mask decomposition such as (but not limited to) insecticides or deodorants?

    a. What effects did this have?

2) Have you encountered the use of lye to reduce odor?

    a. If so, what effects did it have?

3) Have you encountered any efforts of people reducing the insect activity with any insect repellants?

    a. If so, what kind of repellant?

    b. What effects did it have?

4) Have you encountered reason to suspect that the use of deodorants or insecticides affected the postmortem interval (PMI) or time of death estimations in any of your cases?

5) Briefly describe any cases where you suspected the use of a chemical to alter or mask decomposition but lacked any confirmatory test or confession to support the chemical use.

6) What is your official title?

7) My responses are based on _____ years experience.

APPENDIX F

Recruitment Script

My name is Meagan Thumann. I am a part time Autopsy Lab Assistant at OCME Eastern Division in Tulsa. I am a second-year graduate student at Oklahoma State University in the School of Forensic Sciences. I am currently working on my thesis about comparing different attempts taken by criminal offenders to alter or mask decomposition. I am trying to identify attempts taken by criminal offenders and determine the effectiveness of these attempts, specifically attempts involving insect repellents and deodorizers. I would like to perform a short questionnaire for forensic pathologists, forensic anthropologists, forensic archaeologists, and death scene investigators in the state of Oklahoma to see what they have witnessed over the years. The survey is a short word document with 7 items and will only take about 5 minutes to complete. It will be emailed out so that the answers can be typed into the word document and then returned. The survey will remain anonymous and the research is IRB Approved. I have attached a copy of my IRB approval, the participant information and consent sheet, and a copy of the questionnaire. Thank you for taking the time to consider my research.

Meagan Thumann

Oklahoma State University

Forensics Grad Student

(936) 556-3187

APPENDIX G

Instructions to Build an Animal Cadaver Observation Cage

Overview

These instructions are designed to explain how to build decomposition observation cages for small animal cadavers. These instructions provide a list of materials needed, how to prepare the materials, and how to assemble the cages for decomposition experiments.

Introduction

There are several factors that contribute to the process of decomposition. When trying to perform an experiment to evaluate decomposition, the cadavers need to be protected from outside factors such as animals or weather. Animals and insects feed on decomposing remains if they have access and sometimes move remains to other locations. These cages are meant to protect the cadavers from animals, but still allow insects to have access to the remains. The cages help ensure that the cadaver will remain present for the entire experiment so that the decomposition process can be observed without interference from other animals.

Step-by-Step Instructions

Gather Materials. To build this observation cage, gather the following:

- One 20in x 20in piece of hardware cloth with ½ inch mesh width (metal mesh fencing wire)
- One 1in x 6in x 18in Pine board
- 1 yard of 11-gauge hand tie baling wire
- Heavy duty stapler or staple gun
- Measuring tape
- Wire Cutters

Prepare Materials. To prepare the materials to build this observation cage, do the following:

1. Use measuring tape to measure a 10.5in x 18in (H x W) square in the hardware cloth.
2. Use wire cutters to cut out the measured square. See Figure 1 Piece C.
3. Use measuring tape to measure a 6in diameter circle.
4. Use wire cutters to cut out the measured circle.
5. Use wire cutters to cut the circle in half creating two semicircles. See Figure 1 Piece D.
6. Use wire cutters to cut the hand tie baling wire into 8 pieces 4in long.

Assemble Cage. To assemble this observation cage, do the following:

1. Align one long (18in) side of hardware cloth with one long (18in) side of the pine board. These should match in length. See Figure 1 where Side A and one side of Piece C meet.
2. Staple the hardware cloth every 2 inches to the pine board on Side A of Figure 1.
3. Curve the hardware cloth over the top of the pine board to create an arch and reach the other side. (See Figure 1 Piece C)
4. Staple the other long end of hardware cloth to the other long end of pine board as in step 2.
5. Align the straight edge of one semicircle of hardware cloth with the short (6in) side of the pine board. See Figure 1 where Side B and Piece D meet.
6. Staple the hardware cloth every 2 inches to the pine board on Side B of Figure 1.
7. Use 4 pieces (4in) of hand tie baling wire to tie the semicircle to the secured arch (created in step 3) every 2 inches. See Figure 1 where piece C and Piece D meet.
8. Repeat steps 5-7 with the other semicircle of hardware cloth and the other short (6in) side of the pine board.

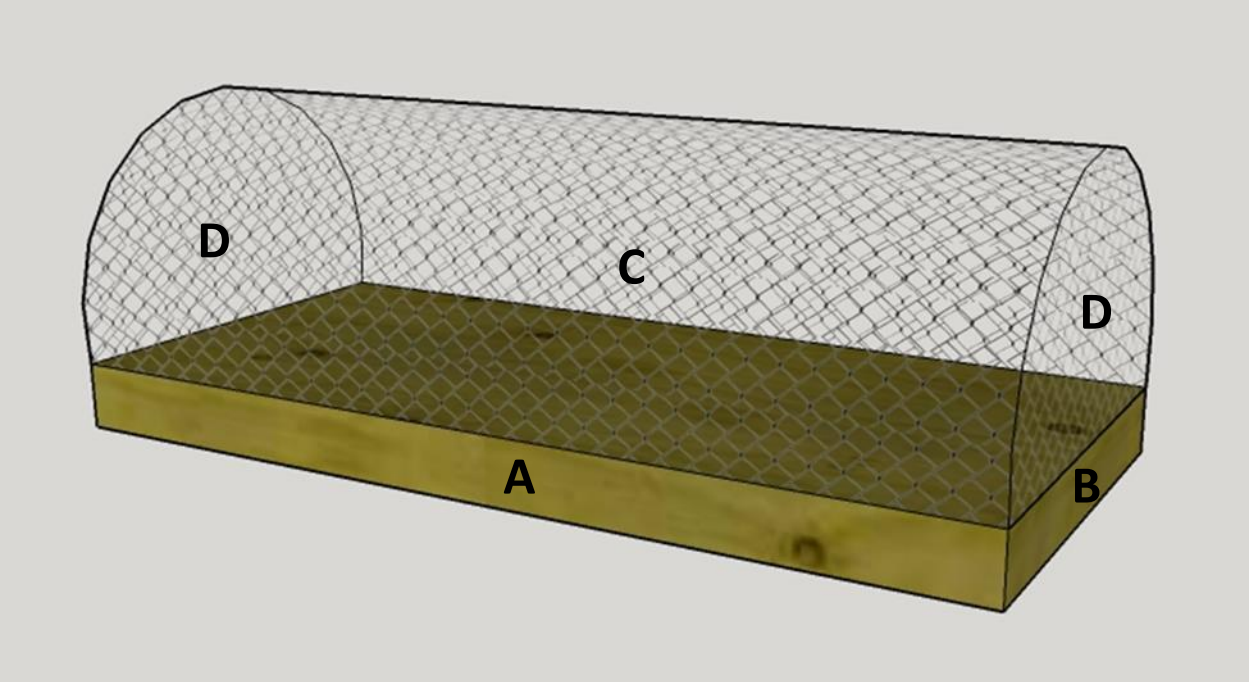


Figure 1. Decomposition Observation Cage Model
(A) Long (18in) side of pine board (B) Short (6in) side of pine board (C) Arch created by 10.5in x 18in square hardware cloth (D) Semicircle (6in diameter) hardware cloth

Conclusion:

Summary. Observation cages, such as this one, allow the chance for experiments to be conducted without interference from some external factors. This cage is meant to protect the cadaver from being carried away by animals, but still allow insects to reach the remains through the hardware cloth. Using these cages will allow the experiment to be as similar as possible to a realistic decomposition situation, but ensure that the remains will not be moved. This design is unique because the ends are tied on with baling wire, allowing the cages to be accessible if needed by opening the ends. This same design can be used in other experiments to build larger cages for larger cadavers if needed.

APPENDIX H

Certificate of Completion for Articulated Ladder Safety

APPENDIX I

Safety Data Sheets for Chemicals Tested in Experiments

Cadaver 2 – Great Value® Bleach SDS

KIK CUSTOM PRODUCTS

SAFETY DATA SHEET

05-Jan-2018

1. IDENTIFICATION

Product identifier
Product Name Great Value Bleach2

Other means of identification
Product UPC 78742-26219
Product Code 23263065031
UN/ID no. 1791

Recommended use of the chemical and restrictions on use
Recommended Use Consumer use. Cleaning agent. Chlorine-based bleaching agents.
Uses advised against Do not mix with other chemicals

Details of the supplier of the safety data sheet

Manufacturer Address
KIK International LLC
33 Macintosh Blvd.
Concord, Ontario
Canada L4K 4L5
1-800-479-6603

Distributor
Wal-Mart Stores, Inc.
702 SW 8th ST.
Bentonville, AR 72712
1-877-505-2267

Emergency telephone number
Emergency Telephone Poison Control Center (Medical) : (866) 366-5048
Chemtrec (Transportation) 1-800-424-9300, 703-527-3887

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin corrosion/irritation	Category 1
Serious eye damage/eye irritation	Category 1
Corrosive to metals	Category 1

Label elements

Emergency Overview

Danger

Hazard statements
Causes severe skin burns and eye damage
May be corrosive to metals

Color light yellow **Physical state** liquid **Odor** Slight chlorine

Precautionary Statements - Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Keep only in original container

Precautionary Statements - Response
Immediately call a POISON CENTER or doctor/physician
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Immediately call a POISON CENTER or doctor/physician
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Immediately call a POISON CENTER or doctor/physician
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Absorb spillage to prevent material damage

Precautionary Statements - Storage
Store locked up
Store in corrosive resistant plastic container with a resistant inner liner

Precautionary Statements - Disposal
Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)
Not applicable

Other Information
0.0039% of the mixture consists of ingredient(s) of unknown toxicity

3. COMPOSITION/INFORMATION ON INGREDIENTS

Mixture

Chemical Name	CAS No.	Weight-%
Sodium hypochlorite	7681-52-9	5

4. FIRST AID MEASURES

Description of first aid measures

General advice Immediate medical attention is required.

Eye contact Immediate medical attention is required. Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Keep eye wide open while rinsing. Do not rub affected area.

Skin contact Immediate medical attention is required. Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes.

Inhalation Remove to fresh air. Call a physician or poison control center immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

Ingestion Immediate medical attention is required. Do NOT induce vomiting. Drink plenty of water. Never give anything by mouth to an unconscious person. Remove from exposure, lie down. Clean mouth with water and drink afterwards plenty of water. Call a physician or poison control center immediately.

Self-protection of the first aider Use personal protective equipment as required. Avoid contact with skin, eyes or clothing.

Most important symptoms and effects, both acute and delayed

Symptoms No information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated. Do not give chemical antidotes. Asphyxia from glottal edema may occur. Marked decrease in blood pressure may occur with moist rales, frothy sputum, and high pulse pressure. Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media No information available.

Specific hazards arising from the chemical
The product causes burns of eyes, skin and mucous membranes. Thermal decomposition can lead to release of irritating and toxic gases and vapors. In the event of fire and/or explosion do not breathe fumes.

Explosion data
Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge None.

Protective equipment and precautions for firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Use personal protective equipment as required. Evacuate personnel to safe areas. Avoid contact with skin, eyes or clothing. Keep people away from and upwind of spill/leak.

Environmental precautions

Environmental precautions Do not allow into any sewer, on the ground or into any body of water. Should not be released into the environment. Prevent further leakage or spillage if safe to do so. Prevent product from entering drains.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Soak up with inert absorbent material. Clean contaminated surface thoroughly. Dike far ahead of liquid spill for later disposal. Take up mechanically, placing in appropriate containers for disposal. Prevent product from entering drains. Dam up. After cleaning, flush away traces with water.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling Avoid contact with skin, eyes or clothing. Use personal protective equipment as required. Ensure adequate ventilation, especially in confined areas. In case of insufficient ventilation, wear suitable respiratory equipment. Use only with adequate ventilation and in closed systems.

Conditions for safe storage, including any incompatibilities

Storage Conditions	Keep container tightly closed in a dry and well-ventilated place. Keep out of the reach of children. Keep containers tightly closed in a dry, cool and well-ventilated place. Keep in properly labeled containers.
Incompatible materials	Acids, Ammonia. Incompatible with strong acids and bases. Incompatible with oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines	This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Appropriate engineering controls

Engineering Controls	Showers Eyewash stations Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection	Tight sealing safety goggles. Face protection shield.
Skin and body protection	Wear protective gloves and protective clothing.
Respiratory protection	If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.
General Hygiene Considerations	When using do not eat, drink or smoke. Wash contaminated clothing before reuse. Keep away from food, drink and animal feeding stuffs. Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended. Avoid contact with skin, eyes or clothing. Take off all contaminated clothing and wash it before reuse. Wear suitable gloves and eye/face protection.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	liquid		
Appearance	Clear with Blue Color, light yellow	**Odor**	Slight chlorine
Color	light yellow	**Odor threshold**	No information available

Property	**Values**	**Remarks • Method**
pH	> 12.5	
Melting point / freezing point	No information available	
Boiling point / boiling range	No information available	
Flash point	No information available	
Evaporation rate	No information available	
Flammability (solid, gas)	No information available	
Flammability Limit in Air		
Upper flammability limit:	No information available	
Lower flammability limit:	No information available	
Vapor pressure	No information available	
Vapor density	No information available	
Specific Gravity	No information available	
Water solubility	Soluble in water	

Solubility in other solvents	No information available
Partition coefficient	No information available
Autoignition temperature	No information available
Decomposition temperature	No information available
Kinematic viscosity	No information available
Dynamic viscosity	No information available
Density	No information available
Bulk density	No information available
Explosive properties	No information available
Oxidizing properties	No information available

Other information

Softening point	No information available
Molecular weight	No information available
VOC Content (%)	No information available

10. STABILITY AND REACTIVITY

Reactivity
No data available
Chemical stability
Stable under recommended storage conditions.

Possibility of Hazardous Reactions
None under normal processing.

Conditions to avoid
Do not mix with other chemicals. Extremes of temperature and direct sunlight. Exposure to air or moisture over prolonged periods.

Incompatible materials
Acids, Ammonia. Incompatible with strong acids and bases. Incompatible with oxidizing agents.

Hazardous Decomposition Products
Thermal decomposition can lead to release of irritating and toxic gases and vapors.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation	Avoid breathing vapors or mists.
Eye contact	Avoid contact with eyes. May cause burns.
Skin contact	Avoid contact with skin. May cause burns.
Ingestion	May be harmful if swallowed.

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Sodium hypochlorite 7681-52-9	= 8200 mg/kg (Rat)	> 10000 mg/kg (Rabbit)	-

Information on toxicological effects

Symptoms No information available.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Sensitization	No information available.
Germ cell mutagenicity	No information available.
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Chemical Name	ACGIH	IARC	NTP	OSHA
Sodium hypochlorite 7681-52-9	-	Group 3	-	-

IARC (International Agency for Research on Cancer)
Not classifiable as a human carcinogen

Reproductive toxicity No information available.
STOT - single exposure No information available.
STOT - repeated exposure No information available.
Chronic toxicity No information available.
Aspiration hazard No information available.

Numerical measures of toxicity - Product Information

12. ECOLOGICAL INFORMATION

Ecotoxicity

Very toxic to aquatic life with long lasting effects

0.0039% of the mixture consists of components(s) of unknown hazards to the aquatic environment

Chemical Name	Algae/aquatic plants	Fish	Crustacea
Sodium hypochlorite 7681-52-9	0.095: 24 h Skeletonema costatum mg/L EC50	0.06 - 0.11: 96 h Pimephales promelas mg/L LC50 flow-through 4.5 - 7.6: 96 h Pimephales promelas mg/L LC50 static 0.4 - 0.8: 96 h Lepomis macrochirus mg/L LC50 static 0.28 - 1: 96 h Lepomis macrochirus mg/L LC50 flow-through 0.05 - 0.771: 96 h Oncorhynchus mykiss mg/L LC50 flow-through 0.03 - 0.19: 96 h Oncorhynchus mykiss mg/L LC50 semi-static 0.18 - 0.22: 96 h Oncorhynchus mykiss mg/L LC50 static	0.033 - 0.044: 48 h Daphnia magna mg/L EC50 Static 2.1: 96 h Daphnia magna mg/L EC50

Persistence and degradability
No information available.

Bioaccumulation
No information available.

Mobility
No information available.

Other adverse effects No information available

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal of wastes Disposal should be in accordance with applicable regional, national and local laws and regulations.

Contaminated packaging Do not reuse container.

US EPA Waste Number D002

14. TRANSPORT INFORMATION

Note: Limited quantity (LQ) exception is possible

DOT

UN/ID no.	1791
Proper shipping name	HYPOCHLORITE SOLUTION
Hazard Class	8
Packing Group	III
Description	UN1791, HYPOCHLORITE SOLUTION, 8, III

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL/NDSL	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

US Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

SARA 311/312 Hazard Categories

Acute health hazard	Yes
Chronic Health Hazard	No
Fire hazard	No
Sudden release of pressure hazard	No
Reactive Hazard	No

CWA (Clean Water Act)
This product contains the following substances which are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

Chemical Name	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
Sodium hypochlorite 7681-52-9	100 lb	-	-	X

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Chemical Name	Hazardous Substances RQs	CERCLA/SARA RQ	Reportable Quantity (RQ)
Sodium hypochlorite 7681-52-9	100 lb	-	RQ 100 lb final RQ RQ 45.4 kg final RQ

US State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania

Sodium hypochlorite 7681-52-9	X	X	X

U.S. EPA Label Information

EPA Pesticide Registration Number 70271-20-41348

EPA Statement

This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets, and for workplace labels of non-pesticide chemicals. Following is the hazard information as required on the pesticide label:

Difference between SDS and EPA Pesticide label

DANGER: Corrosive. May cause severe skin and eye irritation or chemical burns to broken skin. Causes eye damage. Wear safety glasses and rubber gloves when handling this product. Wash after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Avoid breathing vapors. Vacate poorly ventilated areas as soon as possible. Do not return until strong odors have dissipated.

16. OTHER INFORMATION, INCLUDING DATE OF PREPARATION OF THE LAST REVISION

NFPA	Health hazards 3	Flammability 0	Instability 1	Physical and Chemical Properties -
HMIS	Health hazards 3	Flammability 0	Physical hazards 1	Personal protection B

Prepared By Regulatory Affairs
Revision Date 05-Jan-2018
Revision Note No information available

Disclaimer

The information provided in this Material Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

Section 1 - Product and Company Identification

Product Identifiers:

Product name:	**Cutter Backwoods Insect Repellent**
EPA reg. number:	305-51-121
Recommended product use:	Insect Repellent - Aerosol

Details of the Supplier of the Safety Data Sheet:

Manufacturer/Supplier:	Chemsico Div. of United Industries Corp. P.O. Box 142642 St. Louis, MO 63114
For product information:	1-800-767-9927
For medical emergencies:	1-800-633-2873

Section 2 - Hazards Identification

Conforms to Hazard Communication Standard 29 CFR 1910.1200.

GHS Classification of Substance or Mixture:

Physical Hazards GHS Classification	Flammable aerosol - Category 2 Gases under pressure - Compressed gas
Health Hazard GHS Classification	Acute oral toxicity – Category 4 Skin sensitizer – Category 1B

GHS Label Elements:

Hazard pictogram(s):

Signal word: WARNING

Hazard statements:

- Flammable aerosol
- Compressed gas – contents under pressure; may burst if heated
- Harmful if swallowed
- May cause an allergic skin reaction

Precautionary Statements:

- Contents under pressure.
- Do not use or store near heat or open flame.
- Do not puncture or incinerate container.
- Exposure to temperatures above 130°F may cause bursting.
- Wash hands with soap and water after handling. Do not eat, drink or smoke when using this product. If swallowed: Call a poison control center or doctor for treatment advice if you feel unwell. Rinse mouth.
- If skin irritation occurs: Get medical advice/attention. Take off contaminated clothing and wash before reuse.

Section 3 - Composition / Information on Ingredients

Chemical Name	CAS#	Weight Percent
DEET (N,N-Diethyl-m-toluamide)	134-62-3	25.00%
Ethanol	64-17-5	23.00%
Isobutane	75-28-5	8.00%

Note: Ingredients not identified are proprietary or non-hazardous. Values are not product specifications.

Section 4 - First Aid Measures

Eye contact: No special requirements

Skin contact: After returning indoors, wash treated skin with soap and water. Discontinue use if irritation or rash occurs.

Inhalation: No special requirements

Ingestion: Call a poison control center or doctor immediately for treatment advice. Have person sip if able to swallow. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give anything by mouth to an unconscious person.

Note to Physician: Probable mucosal damage may contraindicate the use of gastric lavage.

General advice: If you feel unwell, seek medical advice (show the label where possible). Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Keep out of reach of children.

Section 5 - Fire Fighting Measures

Flammable properties: Pressurized aerosol container

NFPA classification: NFPA level 1 aerosol

Suitable extinguishing media: Water fog, foam, CO_2, dry chemical

Unsuitable extinguishing media: Not available

Specific hazards arising from the chemical: Contents under pressure – container may burst in heat of fire.

Protective equipment for firefighters: Firefighters should wear full protective clothing including self-contained breathing apparatus.

Hazardous combustion products: None known

Explosion data: Not available

Sensitivity to static discharge: Not available

Personal precautions: Keep unnecessary personnel away. Do not touch or walk through spilled material.

Section 6 - Accidental Release Measures

Personnel precautions: Remove all sources of ignition. Wear personnel protective equipment as recommended in Section 8. Wash thoroughly after handling.

For emergency responders: If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials.

Environmental precautions: Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for containment and cleaning up: Stop leak if without risk. Move containers from spill area. Before attempting clean up, refer to hazard data given above. Small spills may be absorbed with earth, sand or absorbent material swept up and placed in suitable, covered, and labeled containers. Prevent large spills from entering sewers or waterways. Contact emergency services and supplier for advice. Never return spills in original containers for re-use.

Section 7 - Handling and Storage

Precautions for safe handling: Put on appropriate personal protective equipment as recommended in Section 8. Pressurized container: protect from sunlight and do not expose to temperatures exceeding 50°C (122°F). Do not pierce or burn, even after use. Do not ingest. Avoid contact with skin, eyes and clothing. Avoid breathing vapor or mist. Use only with adequate ventilation. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical equipment. Use only non-sparking tools. Empty containers retain product residue and can be hazardous.

Storage: Store in a cool, dry area away from open flame. Do not store above 50°C (122°F).

Section 8 - Exposure Controls / Personal Protection

Exposure guidelines:

Components with Occupational Exposure Limits							
		Exposure Limits					
		OSHA PEL		ACGIH TLV		SupplierOEL	
Chemical name		ppm	mg/m³	ppm	mg/m³	ppm	mg/m³
DEET	TWA	None		None		None	
Ethanol	TWA	1000	1900	1000	------	1000	1900
Isobutane	TWA	Not established		1000	------	Not established	

Engineering controls: General ventilation normally adequate.

Personal protective equipment:

Eye/Face protection: During application, prevent entry into eyes. Wear safety glasses with side shields if using in large applications.

Skin and body protection: None required

Respiratory protection: None required

General hygiene considerations: Handle in accordance with good industrial hygiene and safety practices. When using, do not eat or drink. Wash

hands before breaks and immediately after handling the product.

Section 9 - Physical & Chemical Properties

Appearance:	Clear
Color:	Light yellow
Physical state:	Pressurized liquid
Odor:	Ethanol and DEET
Odor threshold:	No data available
pH:	8.8 (liquid portion)
Melting point:	No data available
Freezing point:	No data available
Boiling point:	No data available
Flash point:	85°F (liquid portion)
Flame Extension	6-12"
Flammability limits in air, lower, % by volume:	No data available
Flammability limits in air, upper, % by volume:	No data available
Vapor pressure:	No data available
Vapor density:	No data available
Relative density @ 20°C:	0.955 (liquid portion)
Octanol/water coefficient:	No data available
Auto-ignition temperature:	No data available
Decomposition temperature:	No data available
Solubility:	Miscible in water
Evaporation rate:	No data available
% Volatile organic compounds:	31.2

Section 10 - Chemical Stability & Reactivity Information

Reactivity

Conditions to avoid:	Do not mix with other chemicals.
Incompatible materials:	Avoid strong oxidizers.

Chemical stability

Product stability:	Stable under recommended storage conditions.

Other

Hazardous decomposition products:	None known
Possibility of hazardous reactions:	Hazardous polymerization does not occur.

Section 11 - Toxicological Information

Primary eye irritation:	Non-irritating (EPA tox. category IV)
Primary skin irritation:	Non-irritating (EPA tox. category IV)
Acute dermal:	LD_{50} > 5000 mg/kg (EPA tox. category IV)
Acute inhalation:	LC_{50} > 2 mg/L (EPA tox. category IV)
Acute oral:	LD_{50} > 2000 mg/kg (EPA tox. category III)
Sensitization:	May cause an allergic reaction after repeated contact.
Chronic effects/ Carcinogenicity:	No data available
Mutagenicity:	No data available
Reproductive effects:	No data available
Teratogenicity:	No data available
Ecotoxicity:	No data available

Section 12 - Ecological Information

Environmental effects:	No data available
Aquatic toxicity:	None
Persistence / degradability:	No data available
Bioaccumulation / accumulation:	No data available
Partition coefficient:	No data available
Mobility in environmental media:	No data available
Chemical fate information:	No data available

Section 13 - Disposal Considerations

Waste codes:	Not available
Disposal instructions:	Dispose in accordance with all applicable regulations.
Waste from residues / unused products:	Not available
Contaminated packaging:	Not available

Section 14 - Transportation Information

U.S. Department of Transportation (DOT):	UN-1950, Aerosols, Flammable, 2.1, Limited Quantity
IATA:	UN-1950, Aerosols, 2.1
IMDG:	UN-1950, Aerosols, Flammable, 2, Limited Quantity

Section 15 - Regulatory Information

29 CFR 1910.1200 hazardous chemical Occupational Safety and Health Administration (OSHA):	No
CERCLA (Superfund) reportable quantity:	Not available

Hazard categories

Superfund Amendments and Reauthorization Act of 1986 (SARA):

Immediate Hazard	No
Delayed Hazard	No
Fire Hazard	No
Pressure Hazard	No
Reactivity Hazard	No

Section 302 extremely hazardous Substance:	No
Section 311 hazardous chemical:	No
Clean Air Act (CAA):	Not available
Clean Water Act (CWA):	Not available

State regulations:

FIFRA labeling: This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets, and for workplace non-pesticide chemicals. Following is the hazard information as required on the pesticide label:

Signal word: CAUTION

Precautionary statements: Harmful if swallowed. Use of this product may cause skin reactions in rare cases. Wash treated clothing before wearing it again. Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.

FLAMMABLE. Contents under pressure. Do not use or store near heat or open flame. Do not puncture or incinerate container. Exposure to temperatures above 130°F may cause bursting.

Notification status: All ingredients of this product are listed or are excluded from listing on the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory.

California Prop. 65: This product does not contain any chemicals known to the state of California to cause cancer, birth defects or any other reproductive harm.

Disclaimer: Information contained herein was obtained from sources considered technically accurate and reliable. While every effort has been made to ensure full disclosure of product hazards, in some cases data is not available and is so stated. Since conditions of actual product use are beyond control of the supplier, it is assumed that users of this material have been fully trained according to the requirements of all applicable legislation and regulatory instruments. No warranty, expressed or implied, is made and supplier will not be liable for any losses, injuries or consequential damages which may result from the use of or reliance on any information contained in this document.

Section 16 - Other Information

HMIS ratings:	Health Hazard 1 Flammability 2 Physical Hazard 1
Item number(s):	HG-26283; HG-36283; HG-96280; HG-96281; HG-96282; HG-96283; HG-96482; HG-96611
Formula number(s):	21-1323
Issue date:	2/17/2016

Prepared by:

Spectrum
Division of United Industries Corp.
P.O. Box 142642
St. Louis, MO 63114-0642
(800) 242-1166

Cadaver 4 – Febreze® Fabric Refresher Extra Strength

SAFETY DATA SHEET

Issuing Date: 10-May-2016 **Revision Date:** 10-May-2016 **Version** 1

1. IDENTIFICATION

Product Name	Febreze Fabric Refresher Extra Strength
Product Identifier	90969771_RET_NG
Product Type:	Finished Product - Consumer (Retail) Use Only
Recommended Use	Fabric Refresher.
Manufacturer	PROCTER & GAMBLE - Fabric and Home Care Division Ivorydale Technical Centre 5299 Spring Grove Avenue Cincinnati, Ohio 45217-1087 USA Procter & Gamble Inc. P.O. Box 355, Station A Toronto, ON M5W 1C5 1-800-331-3774
E-mail Address	pgsds.im@pg.com
Emergency Telephone	Transportation (24 HR) CHEMTREC - 1-800-424-9300 (U.S./ Canada) or 1-703-527-3887 Mexico toll free in country: 800-681-9531

2. HAZARD IDENTIFICATION

"Consumer Products", as defined by the US Consumer Product Safety Act and which are used as intended (typical consumer duration and frequency), are exempt from the OSHA Hazard Communication Standard (29 CFR 1910.1200). This SDS is being provided as a courtesy to help assist in the safe handling and proper use of the product.

This product is classified under 29CFR 1910.1200(d) and the Canadian Hazardous Products Regulation as follows:.

Not Classified.

Hazard Statements	None
Hazard pictograms	None
Precautionary Statements	None
Precautionary Statements - Response	None
Precautionary Statements - Storage	None

Precautionary Statements - Disposal	None
Hazards not otherwise classified (HNOC)	None

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients are listed according to 29CFR 1910.1200 Appendix D and the Canadian Hazardous Products Regulation

Chemical Name	Synonyms	Trade Secret	CAS-No	Weight %
Ethanol	Ethanol	No	64-17-5	1 - 5

4. FIRST AID MEASURES

First aid measures for different exposure routes

Eye contact	Rinse with plenty of water. Get medical attention immediately if irritation persists.
Skin contact	Rinse with plenty of water. Get medical attention if irritation develops and persists.
Ingestion	Drink 1 or 2 glasses of water. Do NOT induce vomiting. Get medical attention immediately if symptoms occur.
Inhalation	Move to fresh air. If symptoms persist, call a physician.
Most important symptoms/effects, acute and delayed	None under normal use conditions.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to Physician	Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media	Dry chemical, CO_2, alcohol-resistant foam or water spray. Dry chemical. Alcohol-resistant foam.
Unsuitable Extinguishing Media	None.
Special hazard	None known.
Special protective equipment for fire-fighters	As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.
Specific hazards arising from the chemical	None.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions	Use personal protective equipment. Do not get in eyes, on skin, or on clothing.

Advice for emergency responders: Use personal protective equipment as required.

Environmental precautions: Keep out of waterways
Do not discharge product into natural waters without pre-treatment or adequate dilution

Methods and materials for containment and cleaning up

Methods for containment: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Prevent product from entering drains. Prevent further leakage or spillage if safe to do so.

Methods for cleaning up: Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13).

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling: Use personal protective equipment as required. Keep container closed when not in use. Never return spills in original containers for re-use. Keep out of the reach of children.

Conditions for safe storage, including any incompatibilities

Storage Conditions: Keep containers tightly closed in a dry, cool and well-ventilated place.

Incompatible products: None known.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines: .

Chemical Name	CAS-No	ACGIH TLV	OSHA PEL	Mexico PEL
Ethanol	64-17-5	STEL: 1000 ppm	TWA: 1000 ppm TWA: 1900 mg/m³ (vacated) TWA: 1000 ppm (vacated) TWA: 1900 mg/m³	Mexico: TWA 1000 ppm Mexico: TWA 1900 mg/m³

Chemical Name	CAS-No	Alberta	Quebec	Ontario TWAEV	British Columbia
Ethanol	64-17-5	TWA: 1000 ppm TWA: 1880 mg/m³	TWA: 1000 ppm TWA: 1880 mg/m³	STEL: 1000 ppm	STEL: 1000 ppm

No relevant exposure guidelines for other ingredients

Exposure controls

Engineering Measures: **Distribution, Workplace and Household Settings:**
Ensure adequate ventilation

Product Manufacturing Plant (needed at Product-Producing Plant ONLY):
Where reasonably practicable this should be achieved by the use of local exhaust ventilation and good general extraction

Personal Protective Equipment

Eye Protection: **Distribution, Workplace and Household Settings:**
No special protective equipment required

Product Manufacturing Plant (needed at Product-Producing Plant ONLY):

Use appropriate eye protection

Hand Protection

Distribution, Workplace and Household Settings:
No special protective equipment required

Product Manufacturing Plant (needed at Product-Producing Plant ONLY):
Protective gloves

Skin and Body Protection

Distribution, Workplace and Household Settings:
No special protective equipment required

Product Manufacturing Plant (needed at Product-Producing Plant ONLY):
Wear suitable protective clothing

Respiratory Protection

Distribution, Workplace and Household Settings:
No special protective equipment required

Product Manufacturing Plant (needed at Product-Producing Plant ONLY):
In case of inadequate ventilation wear respiratory protection

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State @20°C	Liquid
Appearance	Clear colorless to Yellow
Odor	Perfume
Odor threshold	No information available

Property	Values	Note
pH value	5.5	
Melting/freezing point	No information available	
Boiling point/boiling range	95 - 100 °C / 203 - 212 °F	
Flash point	No Flash to Boiling (NFTB)	
Evaporation rate	0.56 - 0.72	
Flammability (solid, gas)	No information available	
Flammability Limits in Air		
Upper flammability limit	No information available	
Lower Flammability Limit	No information available	
Vapor pressure	No information available	
Vapor density	No information available	
Relative density	0.97 - 1.03	
Water solubility	No information available	
Partition coefficient: n-octanol/water	No information available	
Autoignition temperature	No information available	-
Decomposition temperature	No information available	-
Viscosity of Product	0.1 - 10 mPa-s	
VOC Content (%)	Products comply with US state and federal regulations for VOC content in consumer products.	

10. STABILITY AND REACTIVITY

Reactivity
None under normal use conditions.

Stability
Stable under normal conditions.

Hazardous polymerization
Hazardous polymerization does not occur.

Hazardous Reactions
None under normal processing.

Conditions to Avoid
None under normal processing.

Materials to avoid
None in particular.

Hazardous Decomposition Products None under normal use conditions.

11. TOXICOLOGICAL INFORMATION

Product Information

Information on likely routes of exposure

Inhalation	No known effect.
Skin contact	No known effect.
Ingestion	No known effect.
Eye contact	No known effect.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Acute toxicity	No known effect.
Skin corrosion/irritation	No known effect.
Serious eye damage/eye irritation	No known effect.
Skin sensitization	No known effect.
Respiratory sensitization	No known effect.
Germ cell mutagenicity	No known effect.
Neurological Effects	No known effect.
Reproductive toxicity	No known effect.
Developmental toxicity	No known effect.
Teratogenicity	No known effect.
STOT - single exposure	No known effect.
STOT - repeated exposure	No known effect.
Target Organ Effects	No known effect.
Aspiration hazard	No known effect.
Carcinogenicity	No known effect.

12. ECOLOGICAL INFORMATION

Ecotoxicity

The product is not expected to be hazardous to the environment.

Persistence and degradability	No information available.
Bioaccumulative potential	No information available.
Mobility	No information available.
Other adverse effects	No information available.

13. DISPOSAL CONSIDERATIONS

Waste treatment

Waste from Residues / Unused Products	Disposal should be in accordance with applicable regional, national and local laws and regulations.
Contaminated packaging	Disposal should be in accordance with applicable regional, national and local laws and regulations.
California Hazardous Waste Codes (non-household setting)	331

14. TRANSPORT INFORMATION

DOT Not regulated

IMDG Not regulated

IATA Not regulated

15. REGULATORY INFORMATION

U.S. Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302):.

Chemical Name	CAS-No	Hazardous Substances RQs	Extremely Hazardous Substances RQs	CERCLA/SARA 302 TPQ
Maleic acid	110-16-7	5000 lb	-	
Sodium hydroxide	1310-73-2	1000 lb	-	

Clean Air Act, Section 112 Hazardous Air Pollutants (HAPs) (see 40 CFR 61)
This product does not contain any substances regulated as hazardous air pollutants (HAPS) under Section 112 of the Clean Air Act Amendments of 1990.

Clean Water Act
This product contains the following substances which are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42):.

Chemical Name	CAS-No	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
Maleic acid	110-16-7	5000 lb	-	-	X
Sodium hydroxide	1310-73-2	1000 lb	-	-	X

California Proposition 65
This product is not subject to warning labeling under California Proposition 65.

U.S. State Regulations (RTK)

-

Chemical Name	CAS-No	New Jersey
Ethanol	64-17-5	X

Chemical Name	CAS-No	Massachusetts
Ethanol	64-17-5	X

Chemical Name	CAS-No	Pennsylvania
Ethanol	64-17-5	X
2,2'-Oxybisethanol	111-46-6	X
Dipropylene Glycol	25265-71-8	X
Maleic acid	110-16-7	X
Ethanol	64-17-5	X

International Inventories

United States
All intentionally-added components of this product(s) are listed on the US TSCA inventory.

Canada
This product is in compliance with CEPA for import by P&G.

Legend
United States Toxic Substances Control Act Section 8(b) Inventory (TSCA)
CEPA - Canadian Environmental Protection Act

16. OTHER INFORMATION

Issuing Date: 10-May-2016
Revision Date: 10-May-2016
Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

Cadaver 5 – Avon® Skin SO Soft Original Body Lotion

VentureTECH CORPORATION

Date of Issue: June 2015

HMIS RATING

GHS SAFETY DATA SHEET

SECTION 1: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: SKIN-SO-SOFT

Synonyms:

Product Details: Proprietary Blend of mild detergents and emollients

Manufactured By: VentureTECH Corporation
10330 Yellow Pine Lane
Knoxville, TN 37932

General Information: (865) 966-2332

Emergency Phone: (865) 544-9400

Trans. Emergency Phone: INFOTRAC: 800-535-5053

SECTION 2: HAZARDS INDENTIFICATION

GHS Classification

Health:		Environmental:		Physical:
Acute Toxicity Inhalation	Category 2	Aquatic Toxicity, Acute	Category 3	
Acute Toxicity Oral/Dermal	NA	Aquatic Toxicity, Chronic	Category 3	
Eye Corrosion	Category 2A			
Skin Corrosion	NA			
Target Organ Toxicity (Single)	Category 3			
Target Organ Toxicity (Repeated)	Category 2			

GHS Label Elements

Symbol:

Hazard Statements:

WARNING!

[x]
Irritant to mouth, throat, esophagus and stomach.
Irritant to mucous membranes of the respiratory tract.
Irritant to eye tissues.

[ ]
Corrosive to mouth, throat, esophagus and stomach.
Corrosive to mucous membranes of the respiratory tract.
Corrosive to eye tissues.

Precautionary Statements:

Harmful if swallowed.
Avoid breathing dusts or mists.
Avoid eye contact.
Wash thoroughly after use.
Use with adequate ventilation.
Chemical type goggles recommended.
Impervious rubber or neoprene gloves recommended.

SECTION 3: COMPOSITION AND INFORMATION ON INGREDIENTS

Principal Hazardous Compound:	Percent:	CAS No:
NONE		

SECTION 4: FIRST AID MEASURES

Eye: For eye irritation. Remove contact lenses. Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Get immediate medical attention.

Skin: For itching or burning of the skin. Immediately flush the skin with plenty of water while removing contaminated clothing and shoes. Get immediate medical attention. Wash contaminated clothing before reuse.

Inhalation: For nasal irritation, headache, dizziness, nausea, vomiting, heart palpitations, breathing difficulty, convuls, tremors, weakness, red flushing of face, irritability, Seek medical attention. Remove exposed person from source of exposure to fresh air. If not breathing, clear airway and start cardiopulmonary resuscitation (CPR). Avoid mouth-to-mouth resuscitation.

Ingestion: Get immediate medical attention. Do not induce vomiting unless directed by medical personnel.

SECTION 5: FIRE FIGHTING MEASURES

Suitable Extinguishing Media: Use water spray, carbon dioxide, fog, foam, or dry chemical as required by surrounding fire.

Fire Fighting Procedures: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Special Protective Equipment or Fire-Fighters: Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Specific Hazards Arising from the Chemical: In a fire or if heated, a pressure increase will occur and a sealed container may burst. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions: Initiate company's spill response procedures immediately. Keep people out of area. Put on appropriate personal protective equipment (see section 8). Do not touch or walk through spilled material.

Environmental Precautions: Avoid contact of spilled material and runoff with soil and surface waterways.

Methods for Cleaning Up: Follow company's spill procedures. Keep people away from spill. Put on appropriate personal protective equipment (see section 8). Absorb/neutralize liquid material. Use a tool to scoop up solid or absorbed material and put into appropriate labeled container. Use a tool to scoop up solid or absorbed material and place into appropriate labeled waste container. Use a water rinse for final clean-up.

SECTION 7: HANDLING AND STORAGE

Handling: Do not get in eyes. Do not breathe vapors or mists. Keep container closed. Use only with adequate ventilation. Use good personal hygiene practices.

Storage: Store in tightly closed containers in cool, dry, well-ventilated area. Keep containers tightly closed and upright when not in use. Protect against physical damage. Keep out of reach of children.

SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Limits: N/A

Personal Protective Equipment (PPE)

Engineering Controls:	Eye Protection:	Skin Protection:	Respiratory Protection:	Other PPE:
Good room ventilation usually adequate. Local exhaust ventilation may be necessary	Wearing chemical safety goggles and/or face shield recommended.	NA	Not required.	NA

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	White Liquid
Odor:	Bouquet
pH:	7-8.5
Specific Gravity:	1.03
Flash Point:	None
Flammability:	Non-Combustible
Relative Density:	8.6lb.
Solubility:	Complete

Data Not Available for the Following Categories:

Odor Threshold	**Partition Coefficient**
Melting/Freezing Point	**Autoignition Temp**
Boiling Range	**Decomposition Temp**
Evaporation Rate	**Viscosity**
Explosive Limits	
Vapor Pressure	
Vapor Density	

SECTION 10: STABILITY AND REACTIVITY

Chemical Stability:	Stable	**Incompatible Materials:**	None known
Possibility of Hazardous Reaction:	NA	**Hazardous Decomposition Products:**	None known
Conditions to Avoid:	None known		

SECTION 11: TOXICOLOGICAL INFORMATION

Primary Route of Exposure:

Eye Contact	[X]
Skin Contact	[X]
Inhalation	[ ]
Ingestion	[X]

Acute Effects:

Eye Contact	May cause severe conjunctival irritation and corneal damage.
Skin Contact	NA
Inhalation	Mists and sprays may cause severe irritation to mucous membranes of respiratory tract.
Ingestion	May cause severe irritation to mouth, throat or gastrointestinal tract.

Signs and Symptoms of Overexposure:
Eye and nasal irritation, headache, dizziness, nausea, vomiting, heart palpitations, difficulty breathing, cyanosis, tremors, weakness, itching or burning of the skin.

Chronic Effects:
Redness and dry skin as normally expected from strong cleaners.

Acute Toxicity Values:
Oral: NA **Dermal:** NA **Inhalation:** NA

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity:	NA
Degradability:	NA
Bioaccumulative Potential:	NA
Mobility in Soil:	NA
Acute Toxicity Values:	NA

SECTION 13: DISPOSAL CONSIDERATIONS

Avoid disposal. Attempt to use product completely in accordance with intended use. Disposal should be in accordance with applicable regional, national and local laws and regulations.

SECTION 14: TRANSPORT INFORMATION

U.S. Department of Transportation (DOT)

UN/NA Number:	NA
Proper Shipping Name:	NA
Hazard Class:	NA
Packing Group:	NA
Marine Pollutant:	NA

SECTION 15: REGULATORY INFORMATION

U.S. Federal Regulations:

TSCA 8(b) Inventory: All components of this product are listed or exempted.

SARA 302/304/311/312 Extremely Hazardous Substances: No listed substance.

SARA 302/304 Emergency Planning and Notification: No listed substance.

This product contains the following toxic chemical(s) subject to reporting requirements of SARA Section 313 (40 CFR 372):

Component	CAS No:	Maximum Percent:

Form R - Reporting Requirements: No listed substance.

California Prop 65: No listed substance.

SECTION 16: OTHER INFORMATION

The information in this data sheet has been assembled by the manufacturer based on its own studies and on the work of others. The manufacturer makes no warranties, express or implied as to the accuracy, completeness, or adequacy of the information contained herein. The manufacturer shall not be liable (regardless of fault) to the vendee, the vendee's employees, or anyone for any direct, special or consequential damages arising out of or in connection with the accuracy, completeness, adequacy or furnishing of such information.

Date of Revision: June 2015

Cadaver 6 – Pelletized Limestone

Austinville Limestone Co. Inc.
223 Newtown Church Rd PO Box 569 Austinville VA 24312
Tel: +1 276 699-6262
Fax: +1 276 699-6323

SAFETY DATA SHEET
Pelletized Limestone

1. IDENTIFICATION

Product Names:
Pelletized Limestone, LawnLime, Pro Pellets, Pro Cal Pellets, Micro Pellets, Micro Cal Pellets

Identified uses:	Acid Soil Treatment
Manufacturer:	Austinville Limestone Co. 223 Newtown Church Rd, Austinville VA 24312
Manufacturing Site:	Austinville Virginia, USA
Emergency Telephone:	+1 (800) 451-8346

2. HAZARD(S) IDENTIFICATION

GHS Classification:	Physical and Chemical Hazards:	Not classified.
	Human Health:	Quartz: STOT RE 1 – H372.
	Environment:	Not classified.

GHS Pictogram:

Signal Word:	Danger
Hazard Statement:	H372 Causes damage to lungs through prolonged or repeated exposure via inhalation.
Precautionary Statements:	P260 Do not breathe dust. P285 In case of inadequate ventilation wear respiratory protection. P501 Dispose of contents/containers in accordance with local regulations.

Long term exposure to crystalline silica can cause lung injury (silicosis). IARC and NTP have determined that crystalline silica inhaled from occupational sources can cause cancer in humans. Risk of injury is dependent on the duration and level of exposure.

3. COMPOSITION / INGREDIENTS

Ground Limestone (Calcium Carbonate)		**>95%**
CAS No.: 1317-65-3	EC No.:	
GHS Classification:	Not classified.	
Quartz		**<1.5%**
CAS No.: 14808-60-7	EC No.: 238-878-4	
GHS Classification:	STOT RE 1 – H372	
Ammonium Lignin Sulfonate		**<3%**
CAS No.: 8061-53-8	EC No.:	
GHS Classification:	Not classified.	
Water		**<0.5%**
CAS No.: 7732-18-5	EC No.:	
GHS Classification:	Not classified.	

4. FIRST-AID MEASURES

Description of first aid measures:

Inhalation:	Remove to fresh air.
Ingestion:	Drink plenty of water. Never give liquid to an unconscious person.
Skin Contact:	Wash skin thoroughly with soap and water.
Eye Contact:	Immediately rinse with water for several minutes.

5. FIRE-FIGHTING MEASURES

Auto Ignition Temperature (°C)	Not applicable.
Flammability Limit – Lower (%)	Not applicable.
Flammability Limit – Upper (%)	Not applicable.
Flash point (°C)	Not applicable.
Extinguishing Media	The product is non-combustible.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions:

Use proper respiratory and personal protective equipment. MSHA / NIOSH or OSHA / NIOSH approved respirator recommended. Spilled materials may cause slippery conditions when wet. Care should be exercised when walking on spills on floors or concrete pads.

Spill Clean Up Methods:

Vacuum, pump or scoop spilled material into containers for reclaiming or disposal. Do not discharge into drains, watercourses or onto the ground.

7. HANDLING AND STORAGE

Handling:
Minimize dust generation and accumulation. If excessive dust is generated, provide adequate ventilation and use proper respiratory and personal protective equipment.

Storage:
Store in a cool and well-ventilated place. Store away from acids.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Component	Standard	TWA (8-hrs)
Limestone	PEL	15 mg/m^3
	ACGIH	2 mg/m^3
Quartz	PEL	0.1 mg/m^3
	ACGIH	0.025 mg/m^3
Ammonium Lignin Binder	PEL	15 mg/m^3
	ACGIH	

Component	IDLH
Quartz	25 mg/m^3

ACGIH: American Conference of Governmental Industrial Hygienists.

Engineering Measures:
Use exhaust ventilation, if required, to maintain dust concentration below recommended exposure limits.

Respiratory Equipment:
If respirator is required, use of a MSHA / NIOSH or OSHA / NIOSH approved respirator is recommended.

Hand Protection:
Rubber gloves are recommended for prolonged exposure.

Eye Protection:
Wear side shield safety glasses

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Granular.
Color:	Brown.
Odor:	Slightly woody odor.
Solubility:	Slightly soluble in water.
Boiling point and boiling range:	Not applicable.
Melting point:	Decomposes at ~825°C.
Flash point:	Not applicable.
Auto Ignition Temperature (°C):	Not applicable.
Flammability Limit – Lower (%):	Not applicable.
Flammability Limit – Upper (%):	Not applicable.

10. STABILITY AND REACTIVITY

Reaction with:	Acids.
Stability:	No particular stability concerns. Not applicable.
Conditions to Avoid:	Avoid contact with acids.

11. TOXICOLOGICAL INFORMATION

Acute toxicity:	Acute Toxicity (Oral LD50)	6450 mg/kg Rat

12. ECOLOGICAL INFORMATION

Ecotoxicity:	The product is not expected to be hazardous to the environment.

13. DISPOSAL CONSIDERATIONS

Disposal Methods:	Under RCRA (40 CFR 261) ground limestone is a non-hazardous waste. Dispose of waste material in accordance with all local, state and federal requirements.

14. TRANSPORT INFORMATION

Environmentally Hazardous Substance / Marine Pollutant

No

15. REGULATORY INFORMATION

OSHA Hazard Communications Standard, 29 CFR 1910.1200: Material is considered hazardous. See Section 2.

RCRA: Material is not defined as a hazardous waste per 40 CFR 261.

CERCLA: Material is not reportable under CERCLA; local requirements may vary.

SARA: 311/312 Hazard Categories – Immediate and Delayed Health; 313 Reportable Ingredients – none.

California Proposition 65: This product contains chemicals known to the State of California to cause cancer.

EU REACh Regulations: Exempted in accordance with Annex V.7

WHIMIS: Limestone products do meet the criteria for WHIMIS classification and are thus not included on the disclosure list

Additional regulatory information available on request

16. OTHER INFORMATION

HEALTH	1
FLAMMABILITY	0
PHYSICAL	0
PERSONAL PROTECTION	E

Disclaimer

This information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is, to the best of the company's knowledge and belief, accurate and reliable as of the date indicated. However, no warranty guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his own particular use.

Revision Date
05/17/2018 SDS No: V21

APPENDIX J

Animal Cadaver Weight Tables from Experiment One

Animal Cadaver Weight Table – Cadaver 2 Bleach – Experiment One

Day	Date	Time	Weight of Cage (lbs)	Weight of Cadaver & Cage (lbs)	Weight of Cadaver (lbs)	Change (lbs)
1	4/18/18	1545	1.73	6.79	5.06	
2	4/19/18	1230	1.73	6.61	4.88	-0.18
3	4/20/18	1225	1.73	6.59	4.86	-0.02
4	4/21/18	1225	1.73	6.66	4.93	0.07
5	4/22/18	1225	1.73	6.43	4.70	-0.23
6	4/23/18	1225	1.73	6.64	4.91	0.21
7	4/24/18	1225	1.73	6.68	4.95	0.04
8	4/25/18	1225	1.73	6.47	4.74	-0.21
9	4/26/18	1226	1.73	6.33	4.60	-0.14
10	4/27/18	1225	1.73	6.24	4.51	-0.09
11	4/28/18	1201	1.73	5.93	4.20	-0.31
12	4/29/18	1155	1.73	5.43	3.70	-0.50
13	4/30/18	1240	1.73	4.56	2.83	-0.87
14	5/1/18	1116	1.73	3.79	2.06	-0.77
15	5/2/18	1230	1.73	3.25	1.52	-0.54
16	5/3/18	1230	1.73	3.17	1.44	-0.08
17	5/4/18	1230	1.73	2.85	1.12	-0.32
18	5/5/18	1115	1.73	2.97	1.24	0.12
19	5/6/18	1118	1.73	2.88	1.15	-0.09
20	5/7/18	1123	1.73	2.98	1.25	0.10
21	5/8/18	1100	1.73	2.83	1.10	-0.15
22	5/9/18	1242	1.73	2.81	1.08	-0.02
23	5/10/18	1218	1.73	2.38	0.65	-0.43
24	5/11/18	1213	1.73	2.78	1.05	0.40
25	5/12/18	1251	1.73	2.81	1.08	0.03
26	5/13/18	1226	1.73	2.84	1.11	0.03
27	5/14/18	1229	1.73	2.79	1.06	-0.05
28	5/15/18	1225	1.73	2.82	1.09	0.03
29	5/16/18	1245	1.73	2.83	1.10	0.01
30	5/17/18	1248	1.73	2.85	1.12	0.02

Animal Cadaver Weight Table – Cadaver 3 DEET – Experiment One

Day	Date	Time	Weight of Cage (lbs)	Weight of Cadaver & Cage (lbs)	Weight of Cadaver (lbs)	Change (lbs)
1	4/18/18	1545	1.72	9.34	7.62	
2	4/19/18	1230	1.72	9.28	7.56	-0.06
3	4/20/18	1225	1.72	9.20	7.48	-0.08
4	4/21/18	1225	1.72	9.27	7.55	0.07
5	4/22/18	1225	1.72	9.01	7.29	-0.26
6	4/23/18	1225	1.72	9.24	7.52	0.23
7	4/24/18	1225	1.72	9.19	7.47	-0.05
8	4/25/18	1225	1.72	9.19	7.47	0.00
9	4/26/18	1226	1.72	9.11	7.39	-0.08
10	4/27/18	1225	1.72	9.01	7.29	-0.10
11	4/28/18	1201	1.72	8.79	7.07	-0.22
12	4/29/18	1155	1.72	8.65	6.93	-0.14
13	4/30/18	1240	1.72	8.52	6.80	-0.13
14	5/1/18	1116	1.72	8.38	6.66	-0.14
15	5/2/18	1230	1.72	8.14	6.42	-0.24
16	5/3/18	1230	1.72	7.76	6.04	-0.38
17	5/4/18	1230	1.72	7.35	5.63	-0.41
18	5/5/18	1115	1.72	6.90	5.18	-0.45
19	5/6/18	1118	1.72	5.92	4.20	-0.98
20	5/7/18	1123	1.72	5.37	3.65	-0.55
21	5/8/18	1100	1.72	4.97	3.25	-0.40
22	5/9/18	1242	1.72	4.82	3.10	-0.15
23	5/10/18	1218	1.72	4.64	2.92	-0.18
24	5/11/18	1213	1.72	4.57	2.85	-0.07
25	5/12/18	1251	1.72	4.48	2.76	-0.09
26	5/13/18	1226	1.72	4.44	2.72	-0.04
27	5/14/18	1229	1.72	4.43	2.71	-0.01
28	5/15/18	1225	1.72	4.39	2.67	-0.04
29	5/16/18	1245	1.72	4.35	2.63	-0.04
30	5/17/18	1248	1.72	4.30	2.58	-0.05

Animal Cadaver Weight Table – Cadaver 4 Febreze® – Experiment One

Day	Date	Time	Weight of Cage (lbs)	Weight of Cadaver & Cage (lbs)	Weight of Cadaver (lbs)	Change (lbs)
1	4/18/18	1545	1.83	10.70	8.87	
2	4/19/18	1230	1.83	10.56	8.73	-0.14
3	4/20/18	1225	1.83	10.58	8.75	0.02
4	4/21/18	1225	1.83	10.48	8.65	-0.10
5	4/22/18	1225	1.83	9.94	8.11	-0.54
6	4/23/18	1225	1.83	10.46	8.63	0.52
7	4/24/18	1225	1.83	10.51	8.68	0.05
8	4/25/18	1225	1.83	10.44	8.61	-0.07
9	4/26/18	1226	1.83	10.41	8.58	-0.03
10	4/27/18	1225	1.83	10.25	8.42	-0.16
11	4/28/18	1201	1.83	9.91	8.08	-0.34
12	4/29/18	1155	1.83	9.41	7.58	-0.5
13	4/30/18	1240	1.83	9.06	7.23	-0.35
14	5/1/18	1116	1.83	8.68	6.85	-0.38
15	5/2/18	1230	1.83	8.05	6.22	-0.63
16	5/3/18	1230	1.83	7.71	5.88	-0.34
17	5/4/18	1230	1.83	7.07	5.24	-0.64
18	5/5/18	1115	1.83	6.59	4.76	-0.48
19	5/6/18	1118	1.83	6.02	4.19	-0.57
20	5/7/18	1123	1.83	5.47	3.64	-0.55
21	5/8/18	1100	1.83	5.27	3.44	-0.2
22	5/9/18	1242	1.83	5.14	3.31	-0.13
23	5/10/18	1218	1.83	5.03	3.20	-0.11
24	5/11/18	1213	1.83	4.95	3.12	-0.08
25	5/12/18	1251	1.83	4.84	3.01	-0.11
26	5/13/18	1226	1.83	4.88	3.05	0.04
27	5/14/18	1229	1.83	4.86	3.03	-0.02
28	5/15/18	1225	1.83	4.86	3.03	0.00
29	5/16/18	1245	1.83	4.85	3.02	-0.01
30	5/17/18	1248	1.83	4.84	3.01	-0.01

Animal Cadaver Weight Table – Cadaver 5 Avon® – Experiment One

Day	Date	Time	Weight of Cage (Lbs)	Weight of Cadaver & Cage (lbs)	Weight of Cadaver (lbs)	Change (lbs)
1	4/18/18	1545	1.79	7.09	5.30	
2	4/19/18	1230	1.79	6.97	5.18	-0.12
3	4/20/18	1225	1.79	6.93	5.14	-0.04
4	4/21/18	1225	1.79	6.90	5.11	-0.03
5	4/22/18	1225	1.79	6.28	4.49	-0.62
6	4/23/18	1225	1.79	6.90	5.11	0.62
7	4/24/18	1225	1.79	6.83	5.04	-0.07
8	4/25/18	1225	1.79	6.91	5.12	0.08
9	4/26/18	1226	1.79	6.89	5.10	-0.02
10	4/27/18	1225	1.79	6.82	5.03	-0.07
11	4/28/18	1201	1.79	6.83	5.04	0.01
12	4/29/18	1155	1.79	6.83	5.04	0.00
13	4/30/18	1240	1.79	6.70	4.91	-0.13
14	5/1/18	1116	1.79	6.39	4.60	-0.31
15	5/2/18	1230	1.79	5.41	3.62	-0.98
16	5/3/18	1230	1.79	4.20	2.41	-1.21
17	5/4/18	1230	1.79	3.24	1.45	-0.96
18	5/5/18	1115	1.79	3.04	1.25	-0.20
19	5/6/18	1118	1.79	2.88	1.09	-0.16
20	5/7/18	1123	1.79	2.91	1.12	0.03
21	5/8/18	1100	1.79	2.87	1.08	-0.04
22	5/9/18	1242	1.79	2.90	1.11	0.03
23	5/10/18	1218	1.79	2.81	1.02	-0.09
24	5/11/18	1213	1.79	2.82	1.03	0.01
25	5/12/18	1251	1.79	2.74	0.95	-0.08
26	5/13/18	1226	1.79	2.82	1.03	0.08
27	5/14/18	1229	1.79	2.84	1.05	0.02
28	5/15/18	1225	1.79	2.83	1.04	-0.01
29	5/16/18	1245	1.79	2.85	1.06	0.02
30	5/17/18	1248	1.79	2.89	1.10	0.04

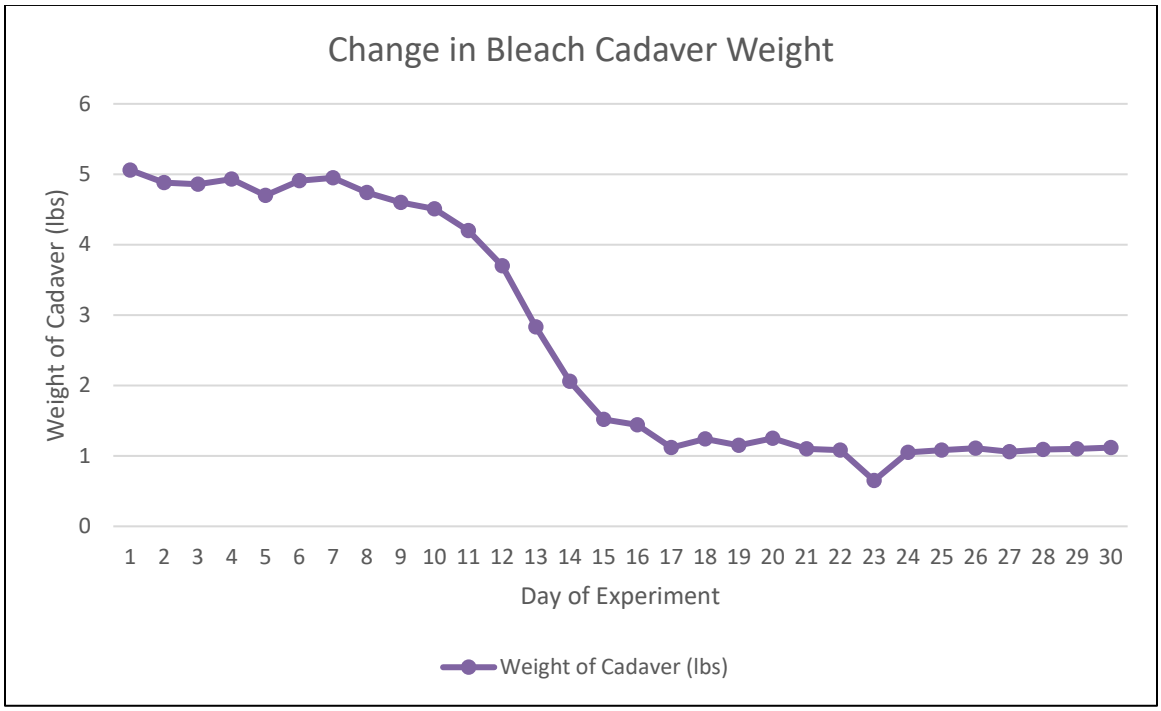
Animal Cadaver Weight Table – Cadaver 6 Lime – Experiment One

Day	Date	Time	Weight of Cage (lbs)	Weight of Cadaver & Cage (lbs)	Weight of Cadaver (lbs)	Change (lbs)
1	4/18/18	1545	1.79	9.05	7.26	
2	4/19/18	1230	1.79	8.71	6.92	-0.34
3	4/20/18	1225	1.79	8.68	6.89	-0.03
4	4/21/18	1225	1.79	8.63	6.84	-0.05
5	4/22/18	1225	1.79	8.04	6.25	-0.59
6	4/23/18	1225	1.79	8.59	6.80	0.55
7	4/24/18	1225	1.79	8.50	6.71	-0.09
8	4/25/18	1225	1.79	8.46	6.67	-0.04
9	4/26/18	1226	1.79	8.36	6.57	-0.10
10	4/27/18	1225	1.79	8.20	6.41	-0.16
11	4/28/18	1201	1.79	7.97	6.18	-0.23
12	4/29/18	1155	1.79	6.98	5.19	-0.99
13	4/30/18	1240	1.79	5.59	3.80	-1.39
14	5/1/18	1116	1.79	4.61	2.82	-0.98
15	5/2/18	1230	1.79	3.78	1.99	-0.83
16	5/3/18	1230	1.79	3.84	2.05	0.06
17	5/4/18	1230	1.79	3.78	1.99	-0.06
18	5/5/18	1115	1.79	3.70	1.91	-0.08
19	5/6/18	1118	1.79	3.57	1.78	-0.13
20	5/7/18	1123	1.79	3.60	1.81	0.03
21	5/8/18	1100	1.79	3.58	1.79	-0.02
22	5/9/18	1242	1.79	3.51	1.72	-0.07
23	5/10/18	1218	1.79	3.51	1.72	0.00
24	5/11/18	1213	1.79	3.47	1.68	-0.04
25	5/12/18	1251	1.79	3.40	1.61	-0.07
26	5/13/18	1226	1.79	3.49	1.70	0.09
27	5/14/18	1229	1.79	3.52	1.73	0.03
28	5/15/18	1225	1.79	3.52	1.73	0.00
29	5/16/18	1245	1.79	3.51	1.72	-0.01
30	5/17/18	1248	1.79	3.52	1.73	0.01

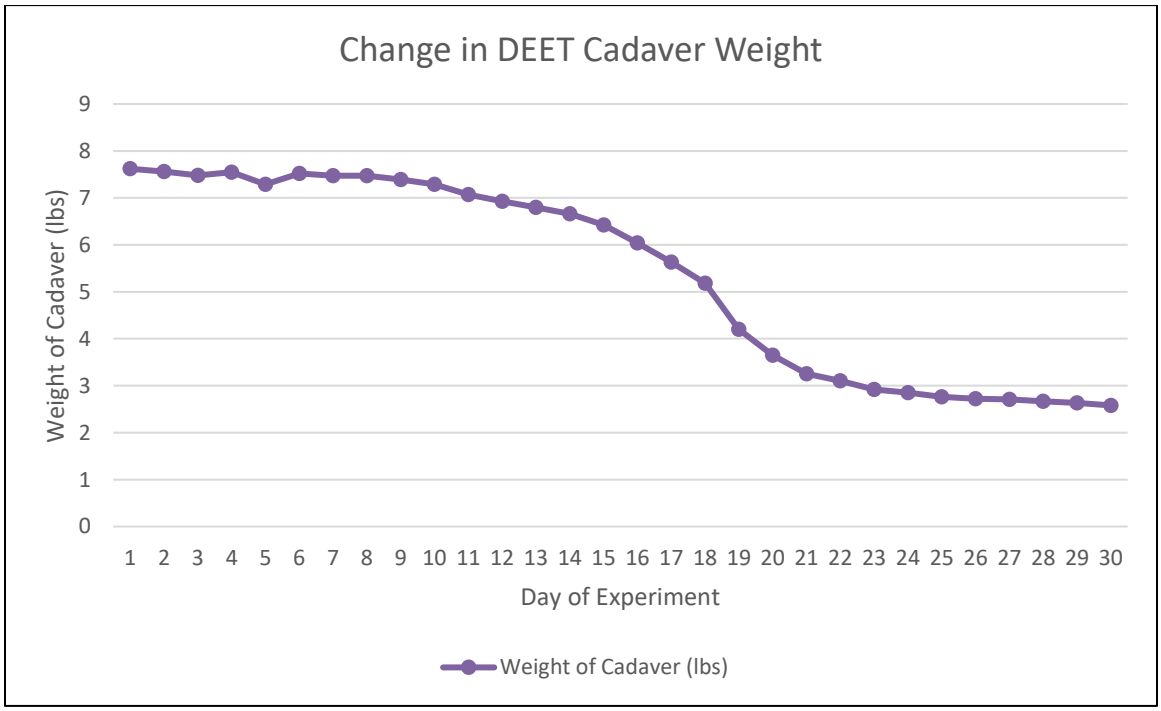
APPENDIX K

Experiment One Change in Animal Cadaver Weight Graphs

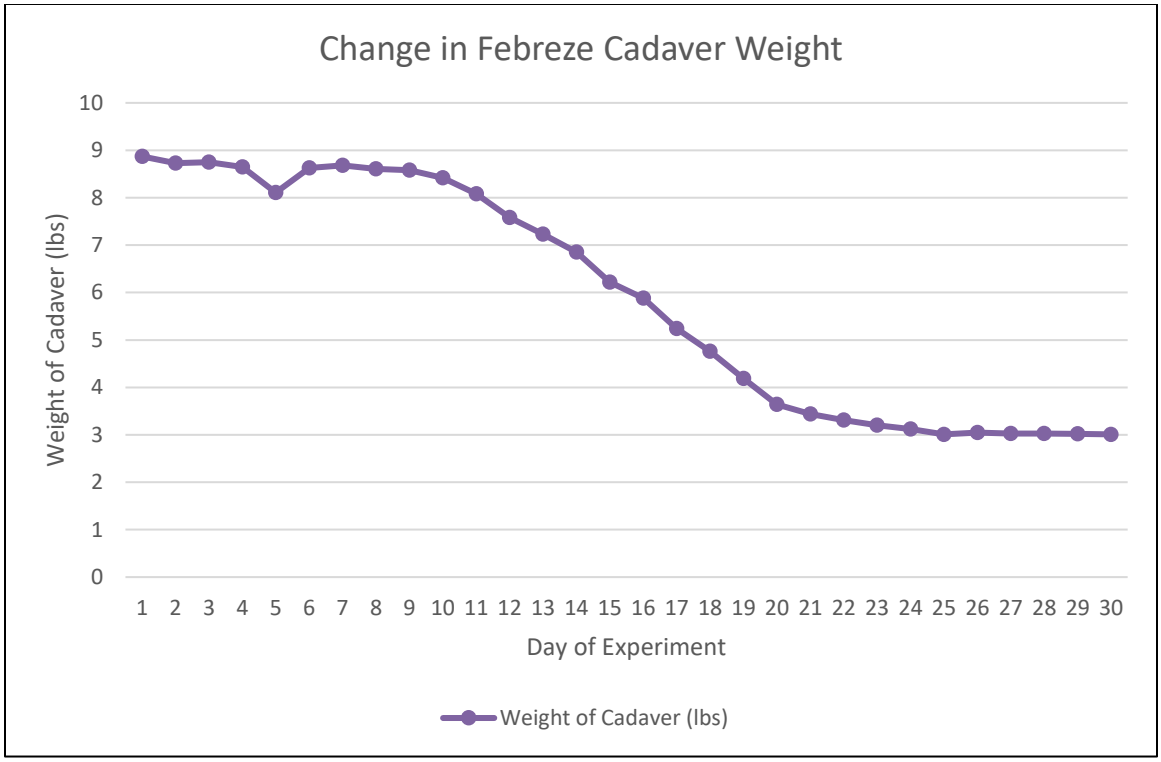
Change in Bleach Cadaver Weight – Experiment One



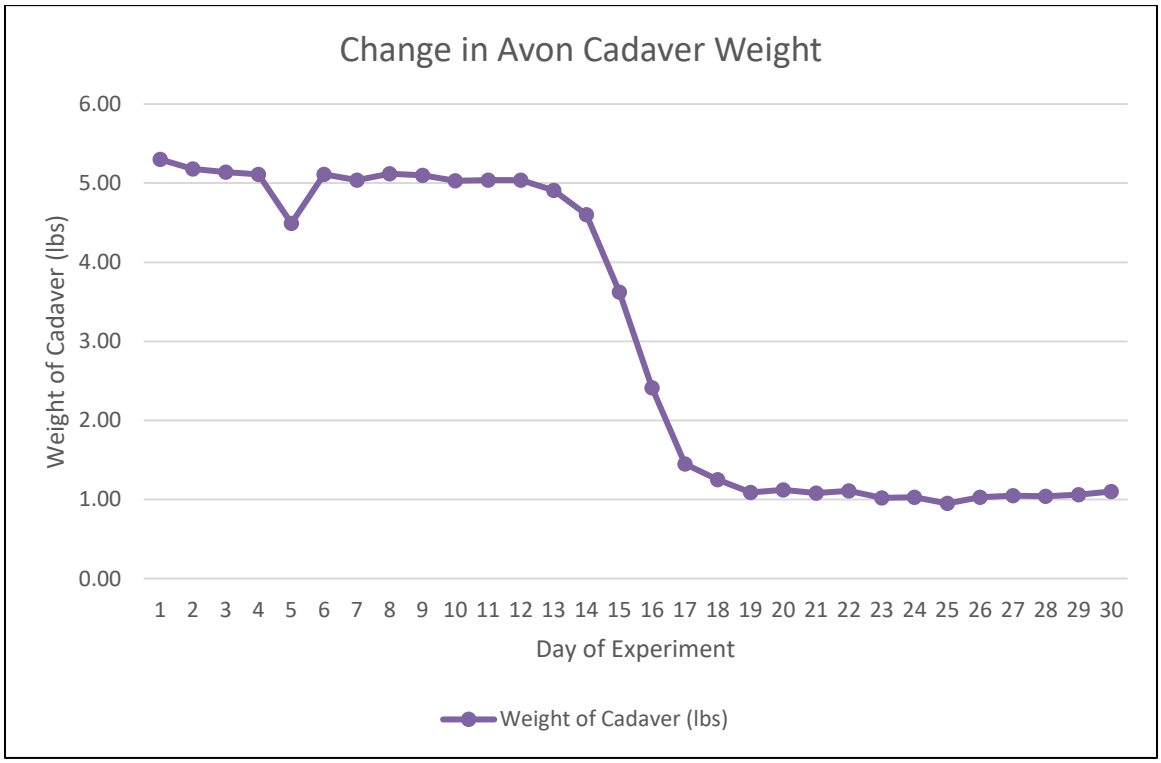
Change in DEET Cadaver Weight – Experiment One



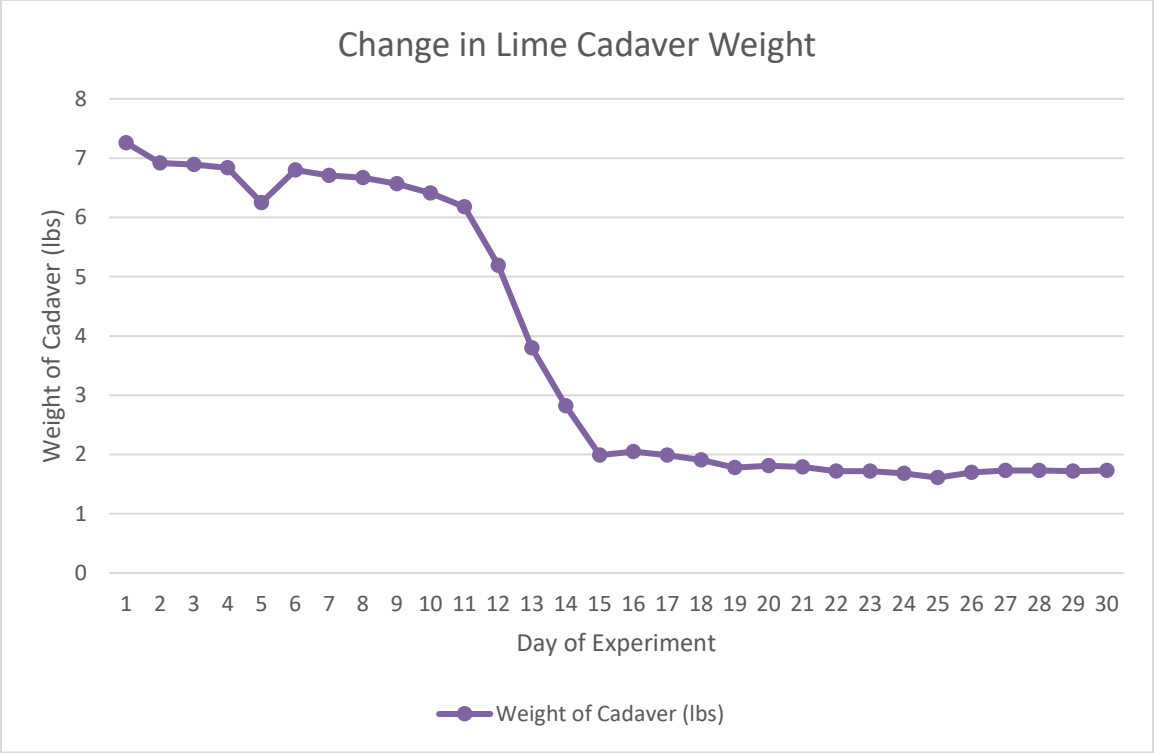
Change in Febreze® Cadaver Weight – Experiment One



Change in Avon® Cadaver Weight – Experiment One



Change in Lime Cadaver Weight – Experiment One



APPENDIX L

Experiment One Animal Cadaver Observations Tables

Animal Cadaver Observation Table – Cadaver 2 Bleach

Day	Date	Odor	Color	Bloating	Fluid	Flies	Maggots	Beetles	Other insects	Other Observations/notes
1	4/18/18	none	none	none	none	none	none	none	none	none
2	4/19/18	none	yellow/brown	none	none	none	none	none	none	none
3	4/20/18	none	yellow/brown	none	none	none	none	none	none	none
4	4/21/18	Slight	yellow/brown	none	none	none	none	none	none	none
5	4/22/18	slight	yellow/brown	none	some from	none	none	none	none	none
6	4/23/18	Slight	yellow/brown	none	some from	several	none	none	none	none
7	4/24/18	strong	yellow/brown	bloated	some from	several	none	none	none	none
8	4/25/18	strong	yellow/brown	bloated	some from nose/mouth	none	none	none	none	insects may have been inside cadaver
9	4/26/18	strong	yellow/brown	bloated	fluid around face/chest	few	several	few	none	maggots on chest/mouth
10	4/27/18	strong	yellow/brown	bloated	some around face/chest	several	none	none	none	couldn't see any maggots, possibly inside cadaver, noticeable decomposition around face, beginning to lose fur
11	4/28/18	strong	yellow/brown	decreased	some around face/chest	several	none	none	none	one maggot on tray, non visible maggots on cadaver, possibly inside, loss of fur on chin/neck/chest
12	4/29/18	strong	yellow/brown	deflated	no new fluid	few	tons	none	none	maggots eating through neck/chest, appears to look like a hole
13	4/30/18	strong	yellow/brown	deflated	no new fluid	none	tons	none	none	maggot mass on side of cage, hole on chest and abdomen, maggots inside holes, maggots near anus, brown black color where skin of holes are drying out, several maggots under cage
14	5/1/18	strong	yellow/brown	deflated	no new fluid	none	tons	none	none	several maggots under the cage
15	5/2/18	strong	yellow/brown	deflated	no new fluid	none	some	none	none	some maggots on cadaver, several under cage, drying out
16	5/3/18	slight	yellow/brown	deflated	no new fluid	none	tons	none	none	loss of fur, seeing skin, drying out, skin sinking in to outline bones, tons of maggots/pupae
17	5/4/18	slight	yellow/brown	deflated	no new fluid	none	none	none	none	odor less noticeable, drying out, no visible maggots on cadaver, less maggots under cage
18	5/5/18	slight	yellow/brown	deflated	no new fluid	none	none	1	none	drying out, maggots under cage
19	5/6/18	Slight	yellow/brown	deflated	no new fluid	none	none	none	none	loss of fur, drying skin is visible on neck/front legs, drying out
20	5/7/18	slight	yellow/brown	deflated	no new fluid	none	none	none	none	no visible maggots on cadaver, drying out
21	5/8/18	slight	yellow/brown	deflated	no new fluid	none	none	none	none	maggots under cage, skin on jaw visible, looks like mummy
22	5/9/18	slight	yellow/brown	deflated	no new fluid	none	none	none	none	flies dying on tarp, loss of fur on front leg/left side of face
23	5/10/18	slight	yellow/brown	deflated	no new fluid	few	none	none	none	loss of fur, no maggots visible on cadaver, flies on tarp/ground, flies flew out from under cinderblocks, skin of front leg/chest visible
24	5/11/18	none	yellow/brown	deflated	no new fluid	none	none	none	none	drying out
25	5/12/18	none	yellow/brown	deflated	no new fluid	none	none	none	none	drying out, fluctuating weight (going up and down)
26	5/13/18	none	yellow/brown	deflated	no new fluid	none	none	none	none	drying out, skin on front leg/chest drying out
27	5/14/18	none	yellow/brown	deflated	no new fluid	none	none	none	none	skin drying out on front leg/chest
28	5/15/18	none	yellow/brown	deflated	no new fluid	none	none	none	none	no new changes, possible showers overnight
29	5/16/18	none	yellow/brown	deflated	no new fluid	none	none	none	none	no new changes, drying out
30	5/17/18	none	yellow/brown	deflated	no new fluid	none	none	none	none	drying out, Removal: all fur detached from bottom of cadaver, skin dried out and stiff

Animal Cadaver Observation Table – Cadaver 3 DEET

Day	Date	Odor	Color	Bloating	Fluid	Flies	Maggots	Beetles	Other insects	Other Observations/notes
1	4/18/18	none	none	none	none	none	none	none	none	
2	4/19/18	none	none	none	none	none	none	none	none	
3	4/20/18	none	none	none	none	none	none	none	none	
4	4/21/18	none	none	none	none	none	none	none	none	
5	4/22/18	none	none	none	none	none	none	none	none	
6	4/23/18	none	none	none	none	none	none	none	none	
7	4/24/18	strong	none	bloated	fluid from nose	few	none	none	none	Very bloated
8	4/25/18	strong	green/blue skin	bloated	fluid from nose	none	none	none	none	
9	4/26/18	strong	green/blue skin	bloated	a lot of fluid from nose	few	none	none	none	1-2 flies, a lot of purge fluid, very bloated
10	4/27/18	strong	green/blue skin	bloated	a lot of fluid from nose	several	some	none	none	maggots hidden near face/neck, very strong odor and a lot of fluid, very bloated
11	4/28/18	strong	green/blue skin	bloated	a lot of fluid	several	none	none	none	very bloated, no visible maggots, possibly inside cadaver
12	4/29/18	strong	gray/brown skin	bloated	blood and purge	several	none	none	none	blood and purge from face and rear end
13	4/30/18	strong	green/blue skin	bloated	a lot of fluid	few	none	none	none	a lot of fluids leaking out and down sides, 2-3 flies, no visible maggots
14	5/1/18	strong	green/blue skin	bloated	a lot of fluid	few	several	none	none	several maggots visible inside the mouth of cadaver
15	5/2/18	strong	green/blue skin	deflatin	a lot of fluid	some	several	none	none	in the process of deflating, maggots in mouth and near anus, 5-10
16	5/3/18	strong	none	deflated	a lot of fluid	none	tons	none	none	tons of maggots inside mouth, eating through mouth and gums, loss of fur
17	5/4/18	strong	none	deflated	a lot of fluid	none	tons	none	none	fluids from head/anus/abdomen, gasses bubling on top of abdomen, maggots in mouth
18	5/5/18	strong	none	deflated	brown/red fluid	several	tons	none	none	brown/red fluids seeping from abdomen, tons of maggots in mouth, see skin on rear end, maggots in fluids, losing fur
19	5/6/18	strong	none	deflated	no new fluid	few	several	none	none	maggots visible in mouth and under cage
20	5/7/18	strong	none	deflated	no new fluid	few	some	none	none	small amount of maggots in mouth, odor slightly less noticeable
21	5/8/18	strong	none	deflated	no new fluid	none	none	none	none	bones in mouth visible, maggots under cage, feet appear wet, possibly from body fluids
22	5/9/18	strong	none	deflated	no new fluid	few	none	none	none	odor slightly less
23	5/10/18	strong	none	deflated	no new fluid	few	none	none	none	2-3 flies, no visible maggots, maggots ate gums in mouth
24	5/11/18	strong	none	deflated	no new fluid	none	none	none	none	drying out
25	5/12/18	strong	none	deflated	no new fluid	none	none	none	none	drying out, possible sludge/hole near rear legs
26	5/13/18	strong	none	deflated	no new fluid	none	none	none	none	no new fluids leaking out, wet/sludge near rear end, possible hole on rear end
27	5/14/18	strong	none	deflated	no new fluid	none	none	none	none	wet/sludge/hole near rear end
28	5/15/18	strong	none	deflated	no new fluid	none	none	none	none	no new changes, flattened, possible showers overnight
29	5/16/18	strong	none	deflated	no new fluid	none	none	none	none	slowly drying out, flattened, Neck/chest on top side furless and dry
30	5/17/18	strong	none	deflated	no new fluid	one	none	none	none	still not dry, appears wet towards rear end, neck dried out with no fur, one fly near cadaver, Removal: all fur detached from bottom of cadaver, Fur didn't come out of cage, fur was stuck to bottom and sides of cage when cadaver removed, skin on bottom still appeared to have moisture in it, not fully dried out yet

Animal Cadaver Observation Table – Cadaver 4 Febreze®

Day	Date	Odor	Color	Bloating	Fluid	Flies	Maggots	Beetles	Other insects	Other Observations/notes
1	4/18/18	Fresh	none	none	none	none	none	none	none	fresh scent of febreze when close to cadaver
2	4/19/18	Fresh	none	none	none	none	none	none	none	fresh scent of febreze when close to cadaver
3	4/20/18	Fresh	none	none	none	none	none	none	none	fresh scent of febreze when close to cadaver
4	4/21/18	Fresh	none	none	none	none	none	none	none	fresh scent of febreze when close to cadaver
5	4/22/18	Fresh	none	none	Fluid near face	none	none	none	none	slight fresh scent of febreze when close to cadaver
6	4/23/18	Fresh	none	slight bloating	Fluid from nose	none	none	none	none	slight fresh scent of febreze when close to cadaver
7	4/24/18	slight decomp	none	bloated	purge from nose	several	none	none	1 spider	very bloated, slight decomp odor, accidentally killed spider
8	4/25/18	slight febreze	none	bloated	purge from nose	one	none	none	none	slight febreze scent when wind blows/super close
9	4/26/18	slight decomp	none	bloated	a lot near face/chest	none	some	one	none	very bloated, maggots near nose/mouth
10	4/27/18	slight decomp	none	bloated	fluid near face/chest	several	none	none	none	very bloated, no visible maggots, possibly inside cadaver
11	4/28/18	strong decomp	none	bloated	fluid near face/chest	several	several	none	none	several maggots in fur/on tarp, losing fur on stomach, brown sludge/fluid on chest/abdomen in loose fur
12	4/29/18	slight decomp	none	bloated	no new fluid	few	some	2-3	none	losing fur, 1-2 flies, small maggots crawling through fur near head, moisture under cage
13	4/30/18	slight decomp	none	bloated	brown fluid/sludge near face/chest/abdomen	none	several	4-6	none	loss of fur on abdomen/face, lots of brown fluid mixing with loose fur, possible hole on abdomen between back legs, possible hole from top on chest/shoulder, several maggots under cage
14	5/1/18	slight decomp	none	bloated	brown fluid/sludge near face/chest/abdomen	none	several	none	none	several maggots under cage, loss of fur near face/neck/chest, maggots everywhere, brown sludge on chest
15	5/2/18	strong decomp	none	bloated	brown fluid near chest	none	several	5-6	none	all fluid coming from underside (chest), maggots on chest, possible hole on chest but can't see through sludge and around legs, loss of fur on chest/abdomen
16	5/3/18	strong decomp	none	bloated	brown fluid near chest	none	tons	none	none	slightly bloated, loss of fur, brown sludge mixed with fur, tons of maggots hidden in fur
17	5/4/18	strong decomp	none	bloated	brown fluid near chest	none	none	3-4	none	loss of fur, no visible maggots
18	5/5/18	strong decomp	none	bloated	no new fluid	few	none	none	none	loss of fur, brown sludge on chest, no visible maggots, slightly less bloated
19	5/6/18	strong decomp	none	slightly less bloating	no new fluid	none	few	none	none	a few visible maggots, brown sludge still present, slowly deflating
20	5/7/18	slight decomp	none	less bloated	no new fluid	none	none	none	none	no visible maggots on cadaver, few maggots on tray, brown sludge present
21	5/8/18	strong decomp	none	same	no new fluid	none	some	none	none	maggots in brown sludge and under cage
22	5/9/18	slight decomp	none	same	no new fluid	none	none	none	none	brown sludge present but drying out, no visible maggots
23	5/10/18	slight decomp	none	same	no new fluid	few	none	none	none	2-3 flies, no maggots visible, fur loss, brown sludge drying out, flies flew out from under cinderblocks
24	5/11/18	slight decomp	none	same	no new fluid	none	none	none	none	brown sludge drying out
25	5/12/18	slight decomp	none	same	no new fluid	none	none	none	none	brown sludge drying out
26	5/13/18	slight decomp	none	same	no new fluid	none	none	none	none	brown sludge drying out
27	5/14/18	slight decomp	none	same	no new fluid	none	none	none	none	brown sludge still present but not fully dried out yet, cadaver is either still slightly bloated or just very large cadaver, has not fully deflated/sunk yet.
28	5/15/18	slight decomp	none	same	no new fluid	none	none	none	none	either still bloated or jst very large, chest still standing, possible showers overnight
29	5/16/18	slight decomp	none	same	no new fluid	none	none	none	none	brown sludge still not dry
30	5/17/18	slight decomp	none	same	no new fluid	none	none	none	none	Still large, not flattened, not dry yet, Removal: fur detached from bottom of cadaver, fur stuck to bottom and sides of cage, skin on bottom dried and stiff

Animal Cadaver Observation Table – Cadaver 5 Avon®

Day	Date	Odor	Color	Bloating	Fluid	Flies	Maggots	Beetles	Other insects	Other Observations/notes
1	4/18/18	fresh	none	none	none	none	none	none	none	fresh scent of Avon lotion when close to cadaver
2	4/19/18	fresh	none	none	none	none	none	none	none	fresh scent of Avon lotion when close to cadaver
3	4/20/18	Slight avon	none	none	none	none	none	none	none	fresh scent of Avon lotion when close to cadaver less noticeable
4	4/21/18	Slight avon	none	none	none	none	none	none	none	fresh scent of avon less noticeable
5	4/22/18	Slight Avon	none	none	fluid from face	none	none	none	none	Fresh scent of acon when up close
6	4/23/18	Slight avon	none	none	minor fluid from nose	none	none	none	none	Avon scent barely noticeable
7	4/24/18	Slight decomp	none	slight bloating	no new fluid	few	none	none	none	Avon scent not noticeable
8	4/25/18	Slight decomp	none	slight bloating	no new fluid	none	none	none	none	no insects possibly due to rain
9	4/26/18	Slight decomp	none	slight bloating	no new fluid	few	none	none	none	two flies
10	4/27/18	Slight decomp	none	slight bloating	no new fluid	few	none	none	none	About 5 flies
11	4/28/18	Slight decomp	none	slight bloating	no new fluid	several	none	none	none	no visible maggots, possibly inside cadaver
12	4/29/18	Slight decomp	none	more bloating	no new fluid	few	few	none	none	2-3 flies, small maggots near face
13	4/30/18	Slight decomp	none	bloated	no new fluid	few	few	none	none	loss of fur on front legs/neck, maggots in nose,
14	5/1/18	Slight decomp	none	deflating	no new fluid	none	few	none	none	maggots in nose, loose fur, deflated slightly from previous day
15	5/2/18	Strong decomp	none	deflated	fluid near rear end	none	some	none	none	appears wet, maggots crawling through fur, loss of fur, fluid near rear end
16	5/3/18	Strong decomp	none	deflated	no new fluid	none	several	none	none	appears wet, maggots in nose/mouth/fur, maggots on tray, under cage, and on ground
17	5/4/18	Strong decomp	none	deflated	no new fluid	none	few	none	none	appears wet, 3-4 maggots in fur, loss of fur, tons of maggots under cage
18	5/5/18	Slight decomp	none	deflated	no new fluid	none	none	none	none	appears wet, no visible maggots on cadaver, loose fur
19	5/6/18	Slight decomp	none	deflated	no new fluid	none	none	none	none	appears wet, no visible maggots on cadaver, maggots under cage and on tray
20	5/7/18	Slight decomp	none	deflated	no new fluid	none	none	none	none	appears wet, leaf from tree on hind quarters, few maggots
21	5/8/18	Slight decomp	none	deflated	no new fluid	none	none	none	none	fur appears wet, maggots under cage, fur loss on face
22	5/9/18	Slight decomp	none	deflated	no new fluid	none	none	none	none	no visible maggots, fur still appears wet
23	5/10/18	Slight decomp	none	deflated	no new fluid	few	none	none	none	appears wet/greasy, flies flew out from under cinderblocks
24	5/11/18	Slight decomp	none	deflated	no new fluid	none	none	none	none	appears wet/greasy, flies under cinderblocks
25	5/12/18	Slight decomp	none	deflated	no new fluid	none	none	none	none	appears slightly wet, few flies under cinderblocks/tarp
26	5/13/18	Slight decomp	none	deflated	no new fluid	few	none	none	none	appears wet/greasy
27	5/14/18	Slight decomp	none	deflated	no new fluid	few	none	none	none	appears wet/greasy
28	5/15/18	Slight decomp	none	deflated	no new fluid	few	none	none	none	appears wet/greasy, a few lethargic flies flew up from tarp when moved, possible showers overnight
29	5/16/18	slight decomp	none	deflated	no new fluid	few	none	none	none	appears wet/greasy, a few lethargic flies around cadaver
30	5/17/18	Slight decomp	none	deflated	no new fluid	none	none	none	none	flattened, appears wet/greasy. Removal: all fur detached from bottom of cadaver, skin dried out and stiff on bottom

Animal Cadaver Observation Table – Cadaver 6 Lime

Day	Date	Odor	Color	Bloating	Fluids	Flies	Maggots	Beetles	Other insects	Other Observations/notes
1	4/18/18	none	none	none	none	none	none	none	none	
2	4/19/18	none	none	none	none	none	none	none	none	Lime blowing away, no moisture to harden lime yet
3	4/20/18	none	none	none	none	none	none	none	none	Lime blowing away, no moisture to harden lime yet
4	4/21/18	none	none	none	none	none	none	none	none	
5	4/22/18	none	none	none	none	none	none	none	none	
6	4/23/18	slight	none	none	from nose	few	none	none	none	
7	4/24/18	strong	none	none	none	several	none	none	none	some moisture in lime
8	4/25/18	strong	none	Bloated	purge fluid	none	none	none	none	more moisture in lime, possibly due to rain
9	4/26/18	strong	Green/blue	bloated	fluids	few	Several	none	none	Seems like lime is missing, looks like fur is missing around anus
10	4/27/18	Strong	none	Bloated	none	several	several	none	none	moisture in lime, maggots hidden near anus
11	4/28/18	strong	none	decreased	none	few	several	none	none	maggots hidden near anus
12	4/29/18	strong	none	deflated	none	few	several	none	none	Deflated and lost fur, drying out/mummifying, hole near chest, several small-medium maggots, a few large fat maggots
13	4/30/18	strong	none	deflated	none	none	Tons	none	none	maggots crawling through fur, looks like just fur due to deflation, see skin of front legs, drying out, tons of maggots in mough, hole in rear end by back hips, can see several maggots and the hip bone
14	5/1/18	strong	none	deflated	none	none	Tons	none	none	tons of maggots undercage or falling off cage
15	5/2/18	strong	none	deflated	none	none	few	none	none	even more deflated, drying out, just looks like loose fur, only a few maggots visible, some maggots under cage
16	5/3/18	slight	none	deflated	none	none	few	none	none	loss of fur, can see skin of front leg, drying out, 1-2 maggots crawling in fur, maggots under cage/ground, can see jaw bone in mouth
17	5/4/18	slight	none	deflated	none	none	few	none	none	skin drying out, one maggot on hardware cloth, maggot fell into fur, major fur loss, very few maggots under cage
18	5/5/18	slight	none	deflated	none	none	none	none	none	can see jaw bone, no visible maggots on cadaver, sin drying out, mostly loose fur
19	5/6/18	slight	none	deflated	none	none	none	none	none	no visible maggots on cadaver, maggots under cage, major fur loss
20	5/7/18	slight	none	deflated	none	none	none	none	none	face/leg skin drying out, lots of loose fur in cage
21	5/8/18	slight	none	deflated	none	none	none	none	none	further skin drying, more fur detaching from skin
22	5/9/18	slight	none	deflated	none	none	none	none	none	smells like cooked meat, possibly due to heat, further drying of skin, hole in skin on hindquarters
23	5/10/18	slight	none	deflated	none	few	none	none	none	flies flew out from under cinderblocks, drying on mouth/front leg, pile of loose fur in cage, hole in rear end, one fly on cadaver
24	5/11/18	slight	none	deflated	none	few	none	none	none	Flies flew out from under cinderblocks, no noticeable changes, drying
25	5/12/18	slight	none	deflated	none	none	none	none	none	no new changes, drying skin
26	5/13/18	slight	none	deflated	none	none	none	none	none	no noticeable changes, drying skin
27	5/14/18	slight	none	deflated	none	none	none	none	none	skin drying out, skin tighter around face/skull, possibly due to drying, lots of loose fur
28	5/15/18	slight	none	deflated	none	none	none	none	none	no visible changes, possble showers overnight
29	5/16/18	slight	none	deflated	no fluid	none	none	none	none	no visible changes, skin still drying out
30	5/17/18	slight	none	deflated	no fluid	none	none	none	none	lots of loose fur, skin dry and stiff on top for neck/chest/front legs, Removal: All fur detached from bottom of cadaver, skin on bottom dried out and stiff

APPENDIX M

Experiment One Photographs

Cadaver 1 Control

Day 1	Day 6
	
Day 10	Day 14
	
Day 18	Day 22
	
Day 26	Day 30
	

Cadaver 2 Bleach

Day 1	Day 6
	
Day 10	Day 14
	
Day 18	Day 22
	
Day 26	Day 30
	

Cadaver 3 DEET (N,N-diethyl-meta-toluamide)

Day 1	Day 6
	
Day 10	**Day 14**
	
Day 18	**Day 22**
	
Day 26	**Day 30**
	

Cadaver 4 Febreze®

Day 1	Day 6
	
Day 10	**Day 14**
	
Day 18	**Day 22**
	
Day 26	**Day 30**
	

Cadaver 5 Avon®

Day 1	Day 6
	
Day 10	**Day 14**
	
Day 18	**Day 22**
	
Day 26	**Day 30**
	

Cadaver 6 Lime

Day 1	Day 6
	
Day 10	**Day 14**
	
Day 18	**Day 22**
	
Day 26	**Day 30**
	

APPENDIX N

Animal Cadaver Weight Tables from Experiment Two

Animal Cadaver Weight Table – Cadaver 2 Bleach – Experiment Two

Day	Date	Time	Weight of Cage (lbs)	Weight of Cadaver & Cage (lbs)	Weight of Cadaver (lbs)	Change (lbs)
1	5/20/18	1305	1.76	6.72	4.96	
2	5/21/18	1235	1.76	6.33	4.57	-0.39
3	5/22/18	1225	1.76	6.17	4.41	-0.16
4	5/23/18	1223	1.76	5.64	3.88	-0.53
5	5/24/18	1245	1.76	5.34	3.58	-0.30
6	5/25/18	1223	1.76	4.97	3.21	-0.37
7	5/26/18	1245	1.76	4.55	2.79	-0.42
8	5/27/18	1207	1.76	3.91	2.15	-0.64
9	5/28/18	1218	1.76	3.16	1.40	-0.75
10	5/29/18	1215	1.76	3.03	1.27	-0.13
11	5/30/18	1225	1.76	2.99	1.23	-0.04
12	5/31/18	1213	1.76	2.94	1.18	-0.05

Animal Cadaver Weight Table – Cadaver 3 Bleach – Experiment Two

Day	Date	Time	Weight of Cage (lbs)	Weight of Cadaver & Cage (lbs)	Weight of Cadaver (lbs)	Change (lbs)
1	5/20/18	1305	1.82	6.97	5.15	
2	5/21/18	1235	1.82	6.33	4.51	-0.64
3	5/22/18	1225	1.82	6.17	4.35	-0.16
4	5/23/18	1223	1.82	5.89	4.07	-0.28
5	5/24/18	1245	1.82	5.57	3.75	-0.32
6	5/25/18	1223	1.82	5.32	3.50	-0.25
7	5/26/18	1245	1.82	4.96	3.14	-0.36
8	5/27/18	1207	1.82	4.38	2.56	-0.58
9	5/28/18	1218	1.82	3.92	2.10	-0.46
10	5/29/18	1215	1.82	3.41	1.59	-0.51
11	5/30/18	1225	1.82	3.32	1.50	-0.09
12	5/31/18	1213	1.82	3.17	1.35	-0.15

Animal Cadaver Weight Table – Cadaver 4 Febreze® – Experiment Two

Day	Date	Time	Weight of Cage (lbs)	Weight of Cadaver & Cage (lbs)	Weight of Cadaver (lbs)	Change (lbs)
1	5/20/18	1305	1.88	6.88	5.00	
2	5/21/18	1235	1.88	6.25	4.37	-0.63
3	5/22/18	1225	1.88	6.04	4.16	-0.21
4	5/23/18	1223	1.88	5.47	3.59	-0.57
5	5/24/18	1245	1.88	4.81	2.93	-0.66
6	5/25/18	1223	1.88	4.14	2.26	-0.67
7	5/26/18	1245	1.88	3.49	1.61	-0.65
8	5/27/18	1207	1.88	3.08	1.20	-0.41
9	5/28/18	1218	1.88	3.00	1.12	-0.08
10	5/29/18	1215	1.88	2.94	1.06	-0.06
11	5/30/18	1225	1.88	2.70	0.82	-0.24
12	5/31/18	1213	1.88	2.88	1.00	0.18

Animal Cadaver Weight Table – Cadaver 5 Avon® – Experiment Two

Day	Date	Time	Weight of Cage (Lbs)	Weight of Cadaver & Cage (lbs)	Weight of Cadaver (lbs)	Change (lbs)
1	5/20/18	1305	1.77	7.48	5.71	
2	5/21/18	1235	1.77	7.12	5.35	-0.36
3	5/22/18	1225	1.77	6.86	5.09	-0.26
4	5/23/18	1223	1.77	6.27	4.50	-0.59
5	5/24/18	1245	1.77	5.58	3.81	-0.69
6	5/25/18	1223	1.77	4.97	3.20	-0.61
7	5/26/18	1245	1.77	3.77	2.00	-1.20
8	5/27/18	1207	1.77	3.34	1.57	-0.43
9	5/28/18	1218	1.77	3.25	1.48	-0.09
10	5/29/18	1215	1.77	3.17	1.40	-0.08
11	5/30/18	1225	1.77	3.17	1.40	0.00
12	5/31/18	1213	1.77	3.13	1.36	-0.04

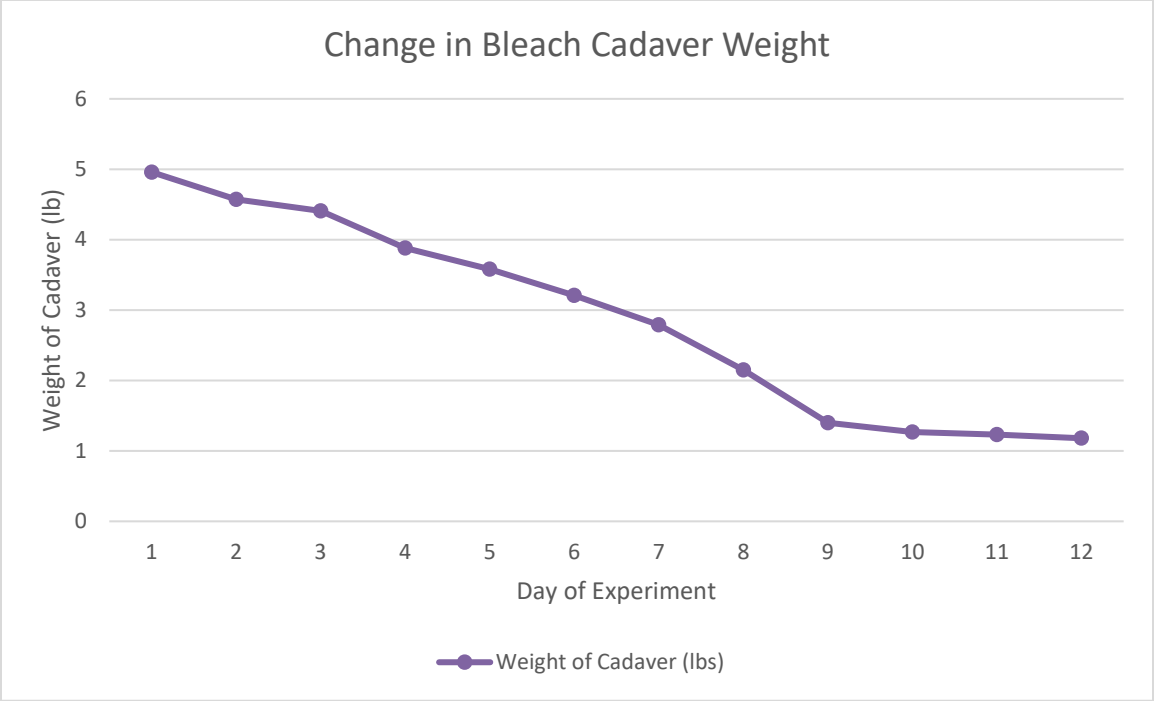
Animal Cadaver Weight Table – Cadaver 6 Lime – Experiment Two

Day	Date	Time	Weight of Cage (lbs)	Weight of Cadaver & Cage (lbs)	Weight of Cadaver (lbs)	Change (lbs)
1	5/20/18	1305	1.81	8.34	6.53	
2	5/21/18	1235	1.81	7.87	6.06	-0.47
3	5/22/18	1225	1.81	7.57	5.76	-0.30
4	5/23/18	1223	1.81	6.88	5.07	-0.69
5	5/24/18	1245	1.81	5.47	3.66	-1.41
6	5/25/18	1223	1.81	4.64	2.83	-0.83
7	5/26/18	1245	1.81	4.03	2.22	-0.61
8	5/27/18	1207	1.81	3.89	2.08	-0.14
9	5/28/18	1218	1.81	3.78	1.97	-0.11
10	5/29/18	1215	1.81	3.76	1.95	-0.02
11	5/30/18	1225	1.81	3.76	1.95	0.00
12	5/31/18	1213	1.81	3.96	2.15	0.20

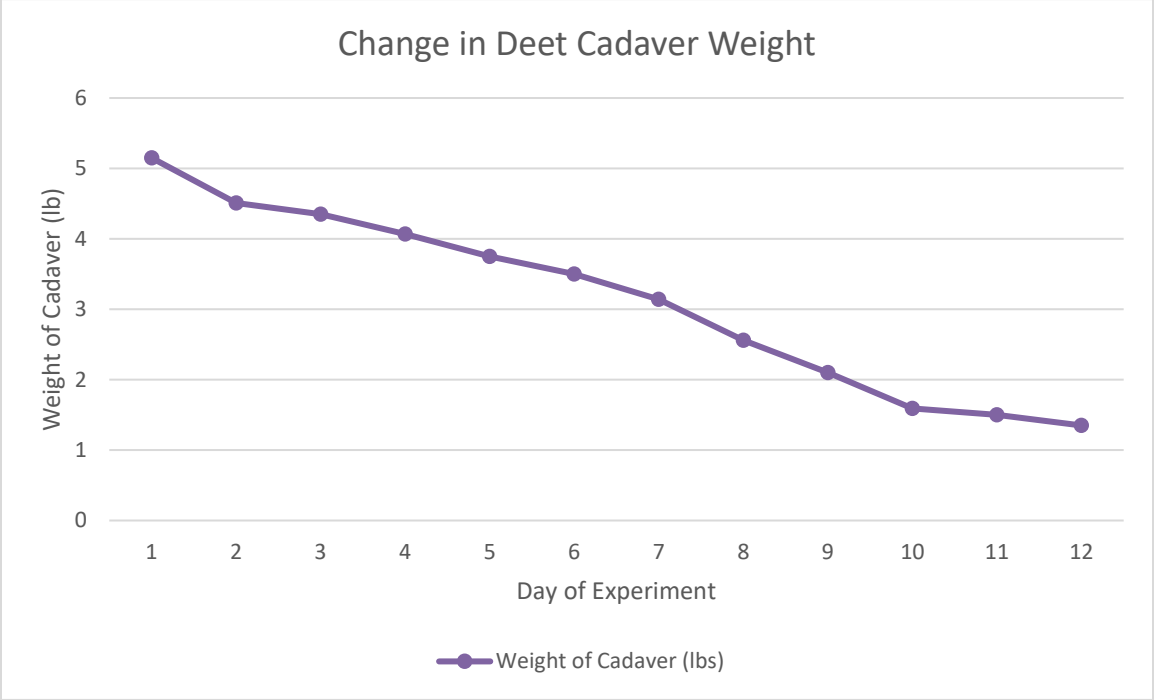
APPENDIX O

Experiment Two Change in Animal Cadaver Weight Graphs

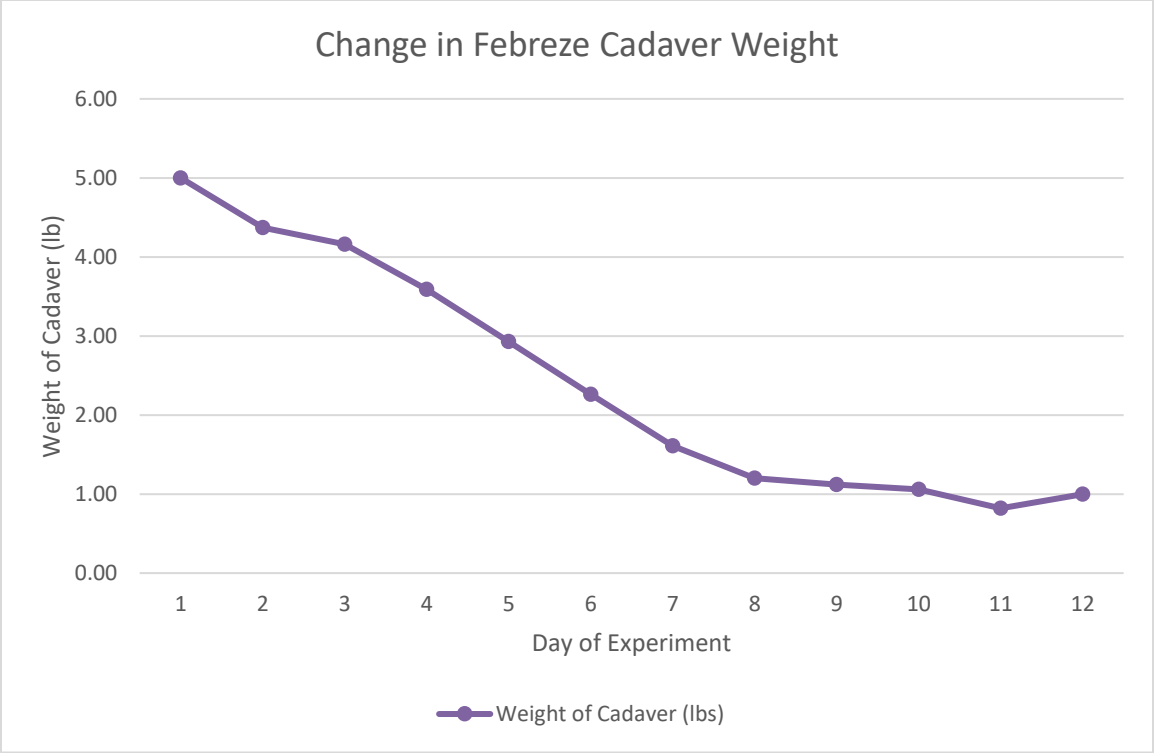
Change in Bleach Cadaver Weight – Experiment Two



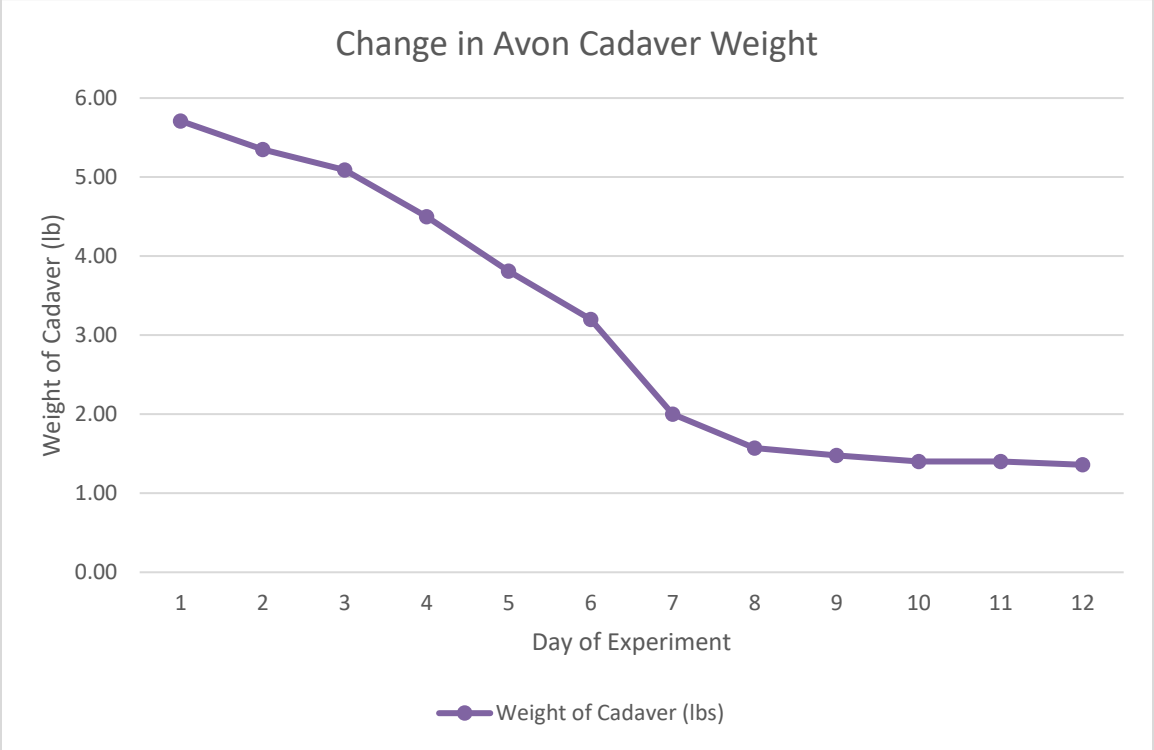
Change in DEET Cadaver Weight – Experiment Two



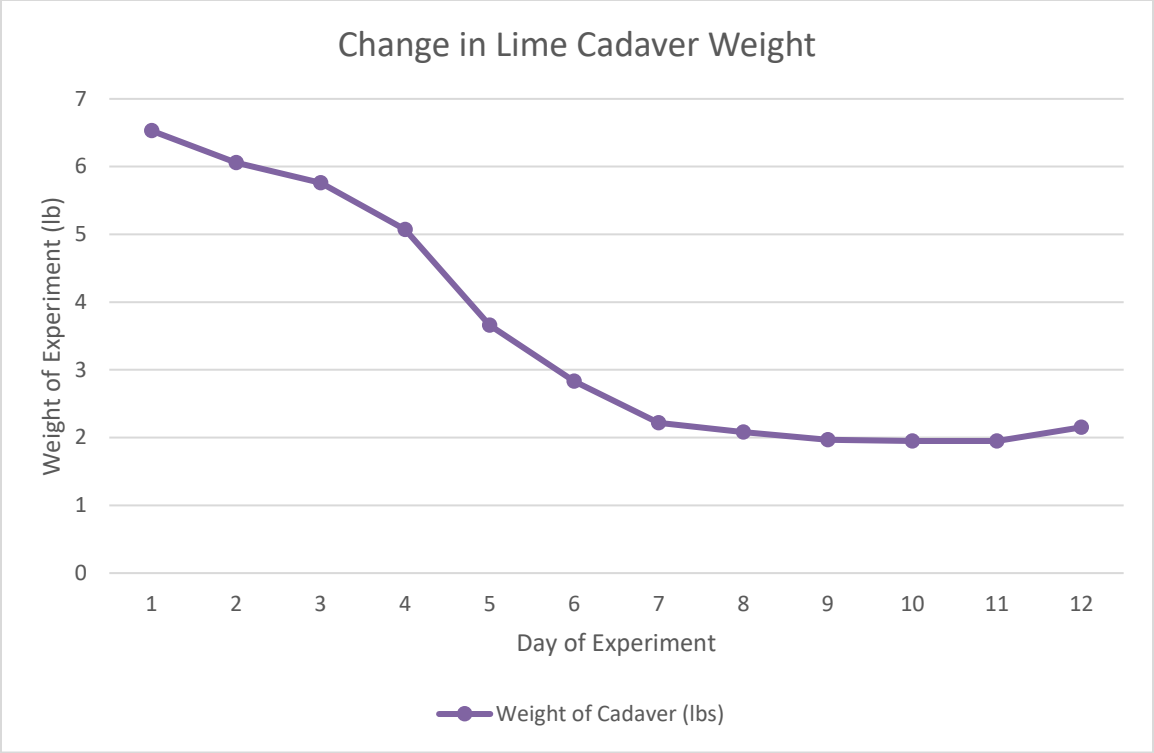
Change in Febreze® Cadaver Weight – Experiment Two



Change in Avon® Cadaver Weight – Experiment Two



Change in Lime Cadaver Weight – Experiment Two



APPENDIX P

Experiment Two Animal Cadaver Observations Tables

Animal Cadaver Observation Table – Cadaver 2 Bleach

Day	Date	Odor	Color	Bloating	Fluids	Flies	Maggots	Beetles	Other insects	Other Observations/notes
1	5/20/18	none	Yellow	none	blood/fluids	none	none	none	none	some blood and fluids from the package, skin looked more yellow after application of bleach
2	5/21/18	none	yellow/	none	blood/fluids	none	none	none	none	skin drying out and turning dark yellow/brown, fluids in pan
3	5/22/18	barely	golden	none	blood/fluids	few	none	none	none	2 flies, skin drying, skin bubbles, odor barely noticeable
4	5/23/18	barely	golden brown	none	blood/fluids	some	some	none	none	odor barely noticeable, 10-15 flies, small maggots or eggs, further skin drying, tons of maggots under cadaver, brown/red
5	5/24/18	strong	golden w/ pink	bloated	brown sludge	few	tons	none	none	tons of tiny new maggots near rear end, brown sludge from rear end, skin bubbles, golden brown with some pink
6	5/25/18	strong	dark	deflating	brown sludge	some	tons	none	none	dark golden brown. Skin drying, skin sinking around bones
7	5/26/18	strong	dark golden	deflating	brown sludge	few	tons	none	none	dark golden brown, deflating, brown sludge at rear, 1-2 flies come and go, appears greasy/wet, some brown sludge from
8	5/27/18	strong	dark golden	deflating	brown sludge	few	tons	none	none	dark golden brown color, appears greasy/wet, fluid/sludge in pan, maggots under the cage
9	5/28/18	strong	dark	deflated	brown sludge	none	none	none	none	sludge and skin drying, looks like just skin and bones, appears
10	5/29/18	strong	dark	deflated	fluid drying	none	none	none	none	looks like skin and bones, appears greasy, skin and fluid drying
11	5/30/18	strong	dark	deflated	fluid drying	none	none	none	none	just skin and bone, appears greasy
12	5/31/18	strong	dark	deflated	rain water	none	none	none	none	just skin and bone, rain water in pan, appears less greasy

Animal Cadaver Observation Table – Cadaver 3 DEET

Day	Date	Odor	Color	Bloating	Fluids	Flies	Maggots	Beetles	Other insects	Other Observations/notes
1	5/20/18	none	none	none	blood/fluids	none	none	none	none	some blood and fluids from the package, Deet was bubbly and running down/around chicken
2	5/21/18	none	yellow/ brown	none	blood/fluids	none	none	none	none	skin drying and slightly turning yellow/brown, brown/red fluids in pan
3	5/22/18	slight	red/ pink	none	blood/fluids	none	none	none	none	skin drying, no noticeable skin bubbles, red/pink color
4	5/23/18	slight	light yellow/ brown	none	blood/fluids	some	none	one	none	10-15 flies, dead beetle and 2 flies in pan, further drying of skin, no visible maggots
5	5/24/18	strong	golden brown	bloated	brown sludge	some	several	none	none	skin drying, 5-10 flies, several small maggots at rear end, some maggot eggs, some brown sludge starting at rear end
6	5/25/18	strong	golden brown	bloated	brown sludge	none	several	none	none	golden yellow/brown with pink, some sludge at the rear end, skin drying, several maggots
7	5/26/18	strong	light golden	deflating	brown sludge	few	tons	none	none	3-5 flies, light golden yellow/brown with some pink, skin sinking around bones, skin drying, tons maggots inside cadaver
8	5/27/18	strong	light golden	deflating	brown sludge	some	tons	none	none	brown sludge from both ends, light golden brown color, skin looks dry
9	5/28/18	strong	light golden	deflating	brown sludge	few	some	none	none	light golden brown color, some maggots inside cadaver, 2 flies, brown sludge at rear, skin drying
10	5/29/18	strong	darker golden	deflated	fluid drying	none	few	none	flying insect	few maggots under cage, a flying bud dead in pan (moth?), fluid and skin drying, slightly greasy appearance, looks like just skin and bone
11	5/30/18	strong	darker golden	deflated	fluid drying	none	none	none	none	just skin and bone, slightly greasy appearance
12	5/31/18	strong	darker golden	deflated	rain water	none	none	none	none	just skin and bone, maggots in fluid in pan, slight greasy appearance

Animal Cadaver Observation Table – Cadaver 4 Febreze®

Day	Date	Odor	Color	Bloating	Fluids	Flies	Maggots	Beetles	Other insects	Other Observations/notes
1	5/20/18	Slight fresh	none	none	blood/fluids	none	none	none	none	some blood and fluids from the package
2	5/21/18	none	yellow/ brown	none	blood/fluids	few	none	none	none	skin drying and turning yellow/brown, some red fluid in pan, 2 flies come and going
3	5/22/18	none	golden/pink	none	blood/fluids	several	none	none	none	skin drying, golden brown with some pink, skin bubbles
4	5/23/18	slight decomp	dark golden	bloated	blood/fluids	several	tons	none	spiky worm	dark golden yellow/brown, tons of maggots/eggs inside and outside, slight dark brown sludge, dark brown/red fluid in pan, spiky worm crawling under cage, dead flies in fluid in pan
5	5/24/18	strong	golden brown	deflating	brown sludge	few	tons	none	none	deflating ot sinking around bones, looks greasy, brown sludge from rear end, maggots under the cage
6	5/25/18	strong	golden brown	deflating	brown sludge	some	tons	none	none	tons of maggots on inside and outside of cadaver, brown sludge from the rear end
7	5/26/18	strong	dark golden	deflating	brown sludge	few	several	none	none	dark golden brown, deflating, sludge near rear end and in pan but drying, appears wet/greasy
8	5/27/18	strong	dark golden	deflated	brown sludge	none	none	none	none	dark golden brown, no visible insects, appears greasy/wet, brown sludge from rear end, looks like just skin and bone
9	5/28/18	strong	dark brown	deflated	brown sludge	none	none	none	none	brown sludge and skin drying, looks like just skin and bone, appears greasy
10	5/29/18	strong	dark brown	deflated	fluid drying	none	none	none	none	fluid and skin drying, appears less greasy, just skin and bone
11	5/30/18	strong	dark brown	deflated	fluid drying	none	none	none	none	just skin and bone, appears less greasy
12	5/31/18	strong	dark brown	deflated	rain water	none	none	none	none	just skin and bone, rain water in pan, appears less greasy

Animal Cadaver Observation Table – Cadaver 5 Avon®

Day	Date	Odor	Color	Bloating	Fluids	Flies	Maggots	Beetles	Other insects	Other Observations/notes
1	5/20/18	none	none	none	blood/fluids	none	none	none	none	some blood and fluids from the package, Appeared white and creamy with lotion sitting on chicken
2	5/21/18	none	yellow	none	blood/fluids	one	none	none	none	one fly came and left, skin drying and turning slightly yellow, lotion is drying on skin in clumps, brown/red fluid in pan
3	5/22/18	none	light golden	none	blood/fluids	several	none	none	none	skin drying, still see moisture from lotion, white lotion spots, light golden brown, looks greasy
4	5/23/18	slight	light golden	bloated	blood/fluids	several	ton	none	none	appears greasy/wet, light yellow/brown, maggots inside and under cadaver, dark brown sludge out rear end, dark brown/red sludge in pan, several dead flies in pan, maggot eggs, large maggots inside cadaver
5	5/24/18	strong	light golden	bloated	brown sludge	some	tons	none	none	light golden yellow, looks greasy, brown sludge from rear end, maggots under the cage
6	5/25/18	strong	golden brown	deflating	brown sludge	few	tons	none	none	brown sludge from the rear end, appears greasy
7	5/26/18	strong	dark golden	deflated	brown sludge	few	several	none	none	dark golden brown, brown/black sludge rear end, appears greasy/wet, bare bones becoming visible
8	5/27/18	strong	dark golden	deflated	brown sludge	none	none	none	none	appears greasy/wet, brown sludge everywhere, looks like just skin and bone, some bone is visible, skin drying
9	5/28/18	strong	dark brown	deflated	brown sludge	none	none	none	none	brown sludge and skin drying, looks like just skin and bones, some bones visible, appears greasy
10	5/29/18	strong	dark brown	deflated	fluid drying	none	none	none	none	fluid and skin drying, appears less greasy, just skin and bones
11	5/30/18	strong	dark brown	deflated	fluid drying	none	none	none	none	just skin and bone, appears less greasy
12	5/31/18	strong	dark brown	deflated	rain water	none	none	none	none	just skin and bone, appears less greasy, rain water in pan

Animal Cadaver Observation Table – Cadaver 6 Lime

Day	Date	Odor	Color	Bloating	Fluids	Flies	Maggots	Beetles	Other insects	Other Observations/notes
1	5/20/18	none	none	none	blood/ fluids	none	none	none	none	some blood and fluids from the package, lime sticking to skin of chicken and piled next to chicken in cage
2	5/21/18	none	yellow/ brown	none	moisture	few	none	none	none	3-5 flies coming and going, lime is a dark brown/black color from absorbing moisture, lime is wet and caked in cage, pan, and on cadaver, some lime on cadaver is drying in thin layered areas, some skin visible and drying to a brown/yellow color on sides
3	5/22/18	barely	golden brown	none	moisture	several	none	none	none	visible skin drying, golden brown with a little pink, lime still dark brown/black, some lime dry and pale (light brown/gray) dry?, lime slightly clumped like a cast, odor barely noticeable
4	5/23/18	slight	golden brown	none	brown sludge	several	ton	none	none	tons of maggots inside, few maggots in lime in pan, lime drying on top and thinned out, more visible skin, a lot of brown sludge from both ends, few skin bubbles, maybe some defating or sinking around bones, maggot eggs visible, visible skin drying
5	5/24/18	strong	dark brown	deflated	brown sludge/ moisture/ muddy	some	tons	none	none	skin that is visible is drying, everything is a dark brown/black color, brown sludge from both ends, brown clumps that are possibly lime clumbs from moisture, almost looks like wet/muddy lime, tons of maggots under the cage
6	5/25/18	strong	dark brown	deflated	muddy lime clumps	few	tons	none	none	skin drying, brown sludge mixed with lime to form muddy lime clumps
7	5/26/18	strong	dark brown	deflated	muddy lime clumps	none	some	none	none	dark brown/black color, muddy lime clumps in cage, on cadaver, and in tray, skin and lime drying, maggots under cage
8	5/27/18	strong	dark brown	deflated	muddy lime clumps	none	some	none	none	dark brown/black color, muddy lime clumps, some maggots on cadaver, under cage, and in lime, skin drying out, appears to be just skin and bone
9	5/28/18	strong	dark brown	deflated	muddy lime clumps	none	none	none	none	no visible insects, looks like just bone and skin, dark brown/black color, lime clumps are drying, skin and lime also drying, appears to be laying flat
10	5/29/18	strong	brown/ black	deflated	Fluid drying	none	few	none	one worm	Dark brown/black color, lime, lime clumps, and skin drying, One spiky/hairy worm under cage, few maggots buried in lime in pan, just skin and bone
11	5/30/18	strong	brown/ black	deflated	fluid drying	none	none	none	none	lime, lime clumps, and skin drying, just skin and bone
12	5/31/18	strong	brown/ black	deflated	rain water	none	none	none	none	just skin and bone, rain water in pan

APPENDIX Q

Experiment Two Photographs

Cadaver 1 Control

Cadaver 1 Control – Day 1	Day 3
	
Day 5	Day 7
	
Day 9	Day 12
	

Cadaver 2 Bleach

Cadaver 2 Bleach – Day 1	Day 3
	
Day 5	Day 7
	
Day 9	Day 12
	

Cadaver 3 DEET

Cadaver 3 DEET – Day 1	Day 3
	
Day 5	Day 7
	
Day 9	Day 12
	

Cadaver 4 Febreze®

Cadaver 4 Febreze® – Day 1	Day 3
	
Day 5	Day 7
	
Day 9	Day 12
	

Cadaver 5 Avon®

Cadaver 5 Avon® – Day 1	Day 3
	
Day 5	Day 7
	
Day 9	Day 12
	

Cadaver 6 Lime

Cadaver 6 Lime – Day 1	Day 3
	
Day 5	Day 7
	
Day 9	Day 12
	

VITA

Meagan D. Thumann

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